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THE GROWTH AND EFFECT OF RAILWAY CONSOLIDATION.

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IT is charged by the politician, it is spread by the press, and it is believed by the people, that railroads, being operated in the interest of the corporations themselves, are operated against the interest of the communities; that by consolidations and combinations all competition is removed, and monopolies are formed which levy extortionate tolls, with no regard to the rights or interests of their patrons. And so dangerous, it is believed, has this arbitrary exercise of power become, that the people of the whole country are invited to bind themselves together into an "anti-monopoly" league, to be able to strike for their liberties, and punish the destroying avarice of these giant corporations.

There is an increasing number of inquiring minds who have come to look with distrust upon the statements of politicians, the opinions of the press, and that popular judgment which is based upon the misinformation furnished by these. It is the purpose of this paper to inquire into these charges and beliefs and endeavor to disclose what truth or error they may contain.

The word *monopoly* is associated in the mind with the legal and artificial monopolies of the last three centuries. Such, for instance, as the Dutch East India Company, which, having the entire product of the Spice Islands, would destroy a portion of the crop rather than lower the price by bringing the whole to market. The workings of all these old monopolies were opposed to the public good, as they were operated in the maintenance of high prices. In England, under the successors of Henry VIII, they had become so numerous and grievous, that by an act of James I, all monopolies were abolished

excepting the right of patents.* To this has since been added, in England and America, the government monopoly of the postal service.

Yet, all railroads are monopolies in a certain sense and to a certain extent; that is to say, they are without practical competition between certain points. The use of the word *monopoly*, however, as applied to railroads, should be qualified by the word *natural*. *Natural monopolies* are such because, under the free and equal operation of the laws of nature and of the nation, they monopolize the business by doing it more satisfactorily, more economically, and more expeditiously, than it can be done by any other means. Insomuch as they fail in this, they are not monopolies. There should not, then, be associated with the idea of natural monopolies the old and well-grounded hatred that existed against legal monopolies. The latter, under the operation of special laws, were operated for the benefit of the few; the former, under the operation of general laws, are operated for the greatest good of the greatest number. There seems no better illustration of the change which has taken place in the meaning of this term in the popular mind than its present application to free competing corporations; and that one, among the prominent measures of reform proposed by the "anti-monopolists," is the absolute destruction of all competition through the operation of the entire railroad system of the country by a great government monopoly.

Combination and consolidation being the spirit of monopoly, are supposed, in the public mind, to be opposed to the common good. But they contain the actual substance of *natural* monopoly, which is such from its merits and benefits, and not from privilege.

Consolidations produce responsibility and uniformity in their service, economy in their operations, and tariffs at minimum rates. These are the essential requirements of the public good, and these the public constantly receive from the great corporations. By the consolidation of several branch lines under a central management, an economy is effected in all those expenses of general supervision, and of junction and terminal stations, which, under the individual operation of the roads, each has to stand by itself. This is, in fact, a reduction of the ratio of expenses to the amount of business done, as it reduces to a minimum those fixed expenses which have little relation to the increase or decrease of traffic; and, as the consolidated company has a much larger traffic over which to distribute these fixed expenses than the short line, it becomes possible for the former to make lower rates and still have the same profit earned by the latter on higher rates.

Again, consolidations are continually being effected between short lines and roads without any through connections. On these the highest rates have always prevailed, because their traffic has been always limited. By a combination with other lines having a common interest, and perhaps by building a short line to connect them, they become

* Blackstone, book iv, p. 159.

part of a through route; and the addition of the through to the former local traffic reduces still further the ratio of the cost of service.

This reduction in the ratio of the cost to the amount of traffic, which results more or less from all consolidations, secures an increase of profits even with no change in the rates or traffic. Thus far there is an injury to no one, and a benefit to the stockholder. But the advantages of the consolidation do not stop here. It has made possible lower rates with the same profit that formerly was earned with higher rates. Without risk of injury the new company is now able to make greater reductions in the rates on those local products of nature and of man, which will allow them to reach more distant markets, or will stimulate their development by enabling them to sell in their former markets with greater profit. By this means, more than by any other, is the railroad enabled to secure an increase of traffic; and, as an increase of traffic can be carried with only a fraction of the relative increase of cost, the decrease of rates increases the net income.

The extension of the same policy leads to the highest development, both of the resources of the country and the earning power of the corporation. To effect the increase of traffic is the constant study and aim of the railroad manager; and it is a self-evident fact that the increase of traffic can only be secured by furthering the interests of the shippers. It is true that all railroads, both great and small, have the same necessary interest in the prosperity and development of the territory served by them, and they all alike endeavor to increase their traffic. But the large corporation, supported by the traffic of the various products of many districts, is in a better condition to experiment in the development of new districts and industries. It frequently affords thus a rate or service beyond the point warranted by the present traffic, and is able to operate portions of its system at a temporary loss, in the hope of a future gain. With a small road, on the other hand, depending upon the present traffic of a limited area, its rates must be immediately remunerative, and to meet the current expenses there is frequently required the practice of every temporary economy, even at the expense of the future value of the property. The small roads, unless the circumstances are exceptional, maintain the highest rates, and afford the poorest service. The interest of the great companies in the development of the districts from which they derive their revenue is in proportion to their size; while their more economical management and extended resources free them from the bonds that confine the small local corporations.

That the advantages accruing from consolidation lead toward the adoption of that policy throughout the world is a conspicuous feature of railroad development; and the facts overwhelmingly demonstrate that the results as constantly lead to a reduction of the tariffs.

The Massachusetts Railroad Commissioners, in their report for 1873 (page 80), draw the following conclusions, after an examination

of the experience of Great Britain upon this subject, which may fairly be taken as an illustration of the general law: "The evidence," they tell us, "published at great length in the 'blue-books,' seems to be almost conclusive that positive benefit rather than injury has there resulted from amalgamation, so far as it has gone. Not only have the evils anticipated not resulted, but it would seem that the public has invariably been better and more economically served by the consolidated than by the independent companies. The larger companies employ abler officers, and seem to be managed more on the system of great departments of commerce, and less on that of lines of stage-coaches; the time and attention of the officers are not mainly absorbed in questions of corporate hostility, and the money of the companies is wasted in a somewhat less degree in warfare with each other; there is, in fact, far less of friction in the work of transportation, and far more of system. Finally, as regards the community at large, it is found that large companies can be held to a closer responsibility than small ones. Their prominence enables public opinion to concentrate upon them—they are more closely watched and held to a stricter account."

In 1872 a committee was appointed by the Parliament of Great Britain to investigate and report upon the supposed evil of railroad amalgamation. From their report Mr. Charles Francis Adams, Jr., in his valuable and interesting work upon "The Railroad Problem," makes the following quotation: "The Northeastern Railway was composed of thirty-seven once independent lines, several of which had formerly competed with each other. Prior to their consolidation these lines had, generally speaking, charged high rates, and they had been able to pay but small dividends. Now, the Northeastern is the most complete monopoly in the United Kingdom; from the Tyne to the Humber it holds the whole country to itself, and it charges the lowest rates and pays the highest dividends of all the great English companies. It was not vexed by litigation; and while numerous complaints were heard from Lancashire and Yorkshire, where railroad competition exists, no one has appeared before the committee to prefer any complaint against the Northeastern."

Mr. Adams, in his comments upon the views and statements of this and other parliamentary committees appointed for similar purposes, concludes as follows: "The clearer political observers have come to realize at last that concentration brings with it an increased sense of responsibility. The larger the railroad corporation, the more cautious is its policy. As a result, therefore, of forty years of experiment and agitation, Great Britain has on this head come back very nearly to its point of commencement. It has settled down on the doctrine of *laissez faire*" (page 94).

If the facts were noticed, the American public could not long resist the same conclusion upon this subject that has been reached in

England. In commenting upon the favorable result of railway consolidation in Great Britain, the chief of the Bureau of Statistics, in his report upon the "Internal Commerce of the United States for 1881" (page 35), says: "A similar result has followed railroad consolidations in the United States. It has heretofore been shown that the average of all the rates charged on fifteen leading railroads of the country, including those of the great East and West trunk-lines, and the principal railroads west of the Alleghany Mountains, engaged in traffic between the Western and Northwestern States and the Atlantic sea-board, has decreased 39·45 per cent since 1870, this reduction in railroad freight charges having been more than three times as great as the average reduction during the same period in the prices of twenty-two of the leading articles of commerce."

This refers to those great trunk-lines against which there is the most frequent charge of monopoly, and upon which, singularly enough, there are the lowest average rates charged by any railroad on the earth.

Yet the objection to using these lines as an illustration of low rates voluntarily made by the companies with the object of increasing their traffic may be made with some appearance of fairness, as they are largely employed in moving the enormous products of the Western States to the sea-board, and the rates upon this portion of their traffic are controlled by the Great Lakes and the Erie Canal, and in part also, perhaps, by competition with one another. We may find an illustration, to which no objection of this kind can be raised, in the great California corporation.

The Central Pacific Railroad Company owns, or controls, with a few exceptions, all the railroads in California, and the western termini of three transcontinental lines. In an address to the people, by the National Anti-Monopoly League (page 15), the condition of railroad competition is stated here as follows: "Monopoly is growing in all the States. It has completely subjugated only one. In California it has ripened its fruit. There, Monopoly is king. There, a few men control steam-transportation. They have annihilated competition." This language has certainly the merit of being vigorous, and is well calculated to influence its hearers by its sound. "Subjugated," "king," and "monopoly," are words which in themselves excite a feeling of rebellion in the breast of a freeman; but, like many other sounding things, they are empty. This great system of roads, having crossed the trackless wastes and pierced the mountain-ranges, has brought a thriving population to thousands of square miles of land which theretofore were uninhabitable and without benefit to humanity. Since the first mile of track was operated by the owners of this company, the surplus earnings have been reinvested in extending its lines, and so increasing its benefits to the community.

Now let us see the effect of this absence of competition by other roads. Let us see if, as the consolidations and extensions have pro-

gressed, the rates have been raised, so that "there is not a producer that does not pay heavier tribute than conquered people ever paid their conquerors."* This is the common expectation and belief. I think there are many who will be disappointed to find that it is not true.

The Central Pacific charged, on its freight traffic in 1872, the average rate of 2·96 cents ; † in 1881 this had been reduced to 2·16 cents ; ‡ an average decrease in the past ten years of eight tenths of a cent on each ton hauled one mile. This is a reduction upon that local traffic which is commonly supposed to be beyond the control of any competition, as well as upon through traffic. This is shown by the fact that the increase of local tonnage for the period was 216 per cent, while the increase of receipts from the same source was but 162 per cent.* Had the average rate of 1872 been maintained by the company on its freight traffic for 1881, the receipts would have been $5,866,287 ‖ more in the latter year than they actually were. During this period of ten years, in which there has been a continuous reduction of rates, the competition by water has remained without change, and competition by rail has not existed ; yet, under the control of the natural laws of trade, there has been such a reduction in the rates on frieght that it now amounts to the annual sum of over five and three quarter million dollars. This additional amount of earnings would have enabled the railroad company to pay a dividend, in 1881, of sixteen per cent, instead of the six per cent which was paid.

It should be observed, also, that the miles of road operated during the period under consideration have been increased from 1,158 in 1872 to 2,707 in 1881,^ a greater portion of which increase has been upon roads built through places almost entirely without inhabitants, and which, as a consequence, for the first few years could furnish but a limited traffic. It will at once be seen that the rates necessary, under such conditions, to pay the cost of service, must have been much higher than in districts where a population and trade already existed. The traffic on these newer portions of the road having been carried at rates which were justly, because necessarily, higher than over the older portion of the line, has had the effect of making the average rate of the whole, in 1881, much higher than it would have been had no new roads been built.

A fair consideration of these facts must, it seems to me, lead to the conclusion that there has been as great a reduction in the rates of this Western system of roads as has taken place in the same time upon any of the Eastern lines.

It is difficult to make any comparison between the operations of

* "Anti-Monopoly Address," p. 15.

† "Central Pacific Railroad Annual Report," 1872.

‡ Poor's "Manual," 1882, p. 868.

* Computed from Annual Reports of the Company for 1872 and 1881.

‖ Poor's "Manual," 1882, p. 868. ^ "Annual Report," 1881, p. 16.

two systems having so few items of resemblance as the California company and the Eastern lines. Yet, if such comparisons are made, with the aim only of discovering the truth, and both systems are placed upon terms as nearly equal as circumstances will admit, there will appear as a result no contrast between the lines where there is the most complete competition and those which are popularly supposed to be controlled only by their own will.

The rates charged by the Pacific coast roads are, on the average, considerably higher than those of the great trunk-lines on the older and more thickly populated side of the continent. This statement presents a natural condition, for the circumstances are necessarily so different in regard to the volume of traffic that almost as great a difference is necessary in rates. The necessity of the difference compels the acknowledgment of its justice. It is obvious that, where a stated traffic will pay the expenses of operating the road and a fair rate of interest on the property, half of the amount of traffic must pay nearly twice the rates in order to produce the same result. Yet, if the popular belief is echoed by the press of California, the rates charged by the Central Pacific system are considered unreasonably high, because they are higher than the charges of the Eastern trunk-lines. The inequality and injustice of this basis of comparison are demonstrated by its application.

The lowest average rate in the United States has been reached upon those lines running between New York and Philadelphia and the West. The charges by these lines average less than one cent upon each ton of freight hauled one mile. Poor's "Manual" for 1881 (pp. 41–47) gives tables of the rates and cost of service of the New York Central, the Erie, the Pennsylvania, and the Pittsburg, Fort Wayne and Chicago Railroads, from which I have made the following comparative statement:

Comparative Statement of Freight Earnings, Expenses, and Traffic for the Year 1880.

	New York Central, 1,018 miles.	Erie, 1,010 miles.	Pennsylvania, 1,120 miles.	Pittsburg, Fort Wayne, and Chicago, 468 miles.	Central Pacific, 2,467 miles.[3]
Freight earn'gs, gross	$22,199,966	$14,391,115	$20,234,046	$7,359,452	$13,252,730[1]
Freight expenses....	13,670,884	9,188,297	10,892,368	4,069,097	5,976,448[1]
Freight earnings, net.	$8,529,082	$5,202,818	$9,341,678	$3,290,355	$7,276,282[1]
Freight earnings, per mile of road, net..	8,378	5,151	8,340	7,122	2,949
Tons freight carried.	10,533,038	8,715,892	15,364,788	3,865,675	2,140,879[2]
Tons carried 1 mile..	2,525,139,145	1,721,112,095	2,298,317,323	806,257,399	565,063,768[2]
Tons carried over each mile of road.	2,480,490	1,704,070	2,052,070	1,722,722	229,050
Average rate, cents..	$\frac{0.8}{100}$	$\frac{0.4}{100}$	$\frac{0.5}{100}$	$\frac{0.1}{100}$	$2\frac{3.4}{100}$ [3]

[1] Report of the Central Pacific Railroad to the State Board of Railroad Commissioners, California, 1880 (unpublished).

[2] "Central Pacific Railroad Annual Report," 1881, p. 14.

[3] Poor's "Manual," 1881, p. 800.

The most conspicuous difference here shown is that between the tonnage of the Central Pacific and the Eastern roads. This must be considered in noticing the rates charged; for the revenue depends not so much upon what rate is charged as what it is charged upon. The average rate of these Eastern roads is $\frac{88}{100}$ of a cent, while the Central Pacific charge is $2\frac{34}{100}$ cents. But, on the other hand, the Eastern lines hauled upon an average, to each mile of road, 1,989,851 tons; which is a rather strong contrast to the 229,050 tons hauled by the Central Pacific. While the average rate of the Western company is two and a half times greater, the tonnage is eight and a half times less than on the Eastern lines. The difference in the rates thus seems to be more than counterbalanced by the great disparity shown in the traffic.

Among other inequalities which command consideration in any comparison of the rates of different roads is, in addition to the amount of traffic, the miles of road on which the traffic is carried. There must clearly be a great difference between the expenses of two lines, the one having 100 miles of road with a traffic of 10,000,000 tons, the other having 1,000 miles of road with the same amount of tonnage—supposing, of course, that the average distance each ton is hauled to be the same in either case. Many of the expenses, in connection with stations, etc., are nearly ten times as great in the latter as in the former case, while all the expenses of maintenance and operation are much greater with the longer than with the shorter line.

There is, of course, added to this, the consideration of the value of the property. A line, for instance, of 100 miles, representing $5,000,000 of value, would make, other things being equal, ten times the profit of a road of 1,000 miles, representing $50,000,000 of value. An equal amount of traffic upon roads between which such disparity exists places the shorter road at a great advantage in any comparison—it would make a larger net profit, though having a smaller capital.

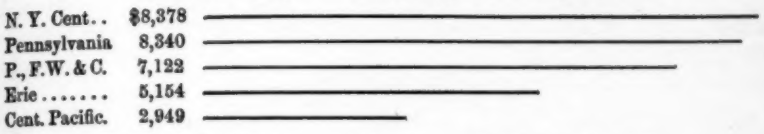
Any approximation to an equality of conditions must thus recognize, in addition to the amount of traffic, the miles of road operated. Taking this into consideration, we find further that the average net earnings per mile of road operated, from the freight traffic on the above Eastern lines, is $7,285; and upon the Central Pacific it is but $2,949. We should consider, on the other hand, that, although the Central Pacific system of roads twice crosses the Sierra Nevadas, has many expensive tunnels and snow galleries that cost $40,000 a mile, yet the Eastern lines represent more value, as a portion of each road has double tracks, and the New York Central, for a distance of 236 miles, has even four parallel tracks.* Fully considering these differences, however, there still appears no such difference in the values as exists in the net earnings. The conclusion, therefore, seems fully justified, that, although the rates on the Central Pacific are greater, the net receipts are less, than on the Eastern lines; and the difference

* "Report of the New York Central Railroad to State Engineer," 1880, p. 9.

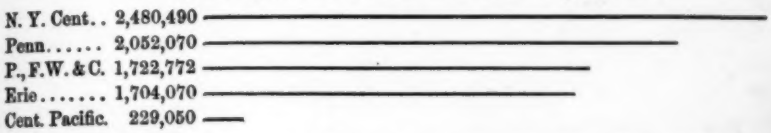
in rates is a necessary and natural result of the difference in the length of lines and the amount of traffic.

The differences, which appear in the above figures, between the lines mentioned, in the net earnings per mile of road operated, and in the tons of freight carried over each mile of road, will be more clearly realized with the aid of the following graphic method of comparative lines, which has been so well employed by Mr. Edward Atkinson:

Net Earnings from Freight, per Mile of Road.



Tons of Freight carried over each Mile of Road.



It would be easy to continue the comparison further, and show that the rates charged on the Eastern lines—whether fair or not upon them—would be unfair if applied to the Central Pacific; for, applied to the traffic of the latter, they would fall far short of paying the necessary expense of the service, while on the former roads they pay not only the expenses, but afford also a profit. But the foregoing facts, it seems to me, sufficiently show that there can be no satisfactory nor fair comparison between the rates on different roads, unless the amount of traffic and the length of line have in each case some approximation. Perhaps the most equitable test, by any comparison which it is possible to furnish of the charge of high rates made against the Central Pacific Company, is supplied by the railroads of Massachusetts.

Here, from the first railroad built in the United States, in 1826, to the present time, there has been a continuous extension of lines by various companies in all directions, till now, according to Mr. Atkinson, the Commonwealth has more miles of railroad in proportion to its territory than exists in any other State or country in the world. These roads represent sixty-four independent corporations.* Here, then, is the greatest contrast to be found between any two systems in regard to consolidation and that competition of parallel roads which is supposed to be the chief regulator of rates. There ought, therefore, according to the popular belief in these matters, to be a contrast equally as great between the rates of the different systems. Here, again, we shall find the popular belief to be in error.

The following table shows the freight earnings, traffic, and rates,

* "Massachusetts Report," 1879, p. 2.

and also the miles of road operated, by the Central Pacific system, compared with the Massachusetts roads:

Central Pacific.

YEARS.	Miles.	Earnings.	Tons one mile.	Rate.
				Cents.
1878.....	2,119	$10,802,276	392,949,592	2·75[1]
1879.....	2,319	10,934,574	449,580,783	2·43[2]
1880.....	2,467	13,245,857	565,063,768	2·34[3]
1881.....	2,707	15,842,139	733,285,889	2·16[4]
Average...	2,403	12,706,211	535,220,080	2·37[7]

Massachusetts.

YEARS.	Miles.	Earnings.	Tons one mile.	Rate.
				Cents.
1873.....	2,365	$16,927,594	615,769,300	2·75[5]
1874.....	2,418	15,771,689	597,085,805	2·64[5]
1875.....	2,459	14,225,535	579,868,963	2·45[5]
1876.....	2,479	13,644,278	628,577,176	2·17[6]
Average...	2,430	15,142,274	605,325,316	2·50[7]

[1] Poor's "Manual," 1879, p. 932.

[2] "Central Pacific Annual Report," 1879, pp. 20, 30. I find, upon examination and inquiry, that Poor's "Manual" for this year repeats the tonnage and rates of the previous year, in error.

[3] Poor's "Manual," 1881, p. 800.

[4] Poor's "Manual," 1882, p. 868. Poor states the rate for 1881 at 2·14 cents, which appears to be the result of an error in calculation. I take 2·16 cents, as calculated from data given.

[5] "Report of the Massachusetts Railroad Commissioners," 1875, pp. 126, 127.

[6] Ibid., 1877, pp. 188, 189.

[7] The rate given in each case is the average per ton per mile for *all* freights. (See "Massachusetts Report," 1877, p. 101.)

To arrive at the latest results the figures taken are for the last four years of the Central Pacific, but, in order to make an equitable comparison in the volume of the tonnage, it is necessary to take the Massachusetts roads for a few years previously. In any corresponding year the Massachusetts roads have a considerably larger tonnage than the Central Pacific; thus, as has been shown, making any fair comparison impossible. Even in the years given they have an annual average of thirteen per cent more tonnage than the Central Pacific, placing the latter system to that amount of disadvantage in the comparison.

On the other hand, however, is the consideration that the prices of material and labor necessary in the operation of railroads have been considerably reduced during the periods shown in the above table, but, in California, they have always been much higher than in the Atlantic States, and were probably higher in the former State in 1881 than they were in Massachusetts in 1876. The relative conditions seem, upon the whole, as fair as it is possible to make them between any two systems.

As a result, the following more important comparisons may be noticed: The average mileage of road operated is about the same in

each case. While, on the Massachusetts roads, the average annual tonnage is thirteen per cent more, the earnings are nineteen per cent more, and the average difference in rates is $\frac{13}{100}$ of a cent more than on the Central Pacific system.

This brings us to the unexpected conclusion that, had the rates charged by the Central Pacific prevailed with the Massachusetts roads, it would have effected an annual saving to that State of $786,923, and this, notwithstanding the fact that the through freight, upon which the lowest rates always prevail, was fifty-eight per cent of the whole traffic in Massachusetts,* while upon the Central Pacific† it was but thirty-nine per cent.

It may be of interest to bring the affairs of this great corporation home to its own State, and see how it compares there with other roads which are independent of it.

In California, in 1878‡ (the last year for which statistics have been published), there were 1,170 miles of road, of which 844 miles were controlled by the Central Pacific, and 326 miles were of small roads, none of which were of sufficient magnitude to create envy or gain the appellation of monopoly. The average rates of eleven of these shorter roads, representing 248 miles, are stated by the State Commissioner of Transportation, from whose report I take the following figures:

Table of Rates on Railroads not controlled by the Central Pacific Railroad Company, reported by the Commissioner of Transportation of California, for the Year 1878.

Miles of road operated. Table II.	NAME OF ROAD.	AVERAGE RATE. Freight, per ton. Table XV.	AVERAGE RATE. Per passenger. Table XV.
		Cents.	Cents.
6·	Black Diamond Coal Company	33·33	8·33
26·50	California Northern	5·86	7·50
5·33	Pittsburg	9.	....
106·24	San Francisco and Northern Pacific	....	3·91
29·	Vaca Valley and Clear Lake	7·	8·
4·	Mendocino	7·87	....
22·64	Nevada County Narrow-Gauge	16·89	8·14
10·67	San Luis Obispo and Santa Maria Valley	15·	8·
21·16	Santa Cruz	9·	7·50
9·	Santa Cruz and Felton	8·19	....
7·33	Visalia	....[1]	10·
247·87	Total miles.		
	Average rates	12·46	6·82

[1] For the Visalia Railroad, the average rate for freight stated in the report of the commissioner is 1½ cent. This, upon examination, proves to be an error. In the same report, p. 183, the highest rate is stated at $68\frac{5}{17}$ cents, the lowest at 2 cents, and the average 1½ cent. This is, of course, impossible. In the report of the previous

* "Massachusetts Reports." † "Central Pacific Railroad Annual Reports."

‡ Report of Commissioner of Transportation, Table II.

commissioners, for June 30, 1876, p. 132, the highest rate is stated at 68$\frac{5}{11}$ cents, and the lowest at 6$\frac{7}{11}$ cent. I have, therefore, omitted the rate given of 1½ cent from the above table.

As these short lines are supported entirely by local traffic, a proper comparison of their rates with those of the Central Pacific should consider only the local rates of the latter. The commissioner, in the same table, furnishes us with these, so that we are enabled to make the following comparison :

The average charge per passenger per mile was, on the short lines, 6$\frac{82}{100}$ cents ; on the Central Pacific (for local only), 2$\frac{83}{100}$ cents. The average charge per ton of freight per mile was, on the short lines 12$\frac{46}{100}$ cents ; and on the Central Pacific—for local only—3$\frac{25}{100}$ cents.

Here, again, the facts show that this great California corporation, which is charged by the Anti-Monopoly League with constant and destroying extortion, has much lower average rates than these smaller companies which are not conspicuous enough in size or wealth to draw the attention of the press or the attacks of politicians.

The tendency of railroad ownership and management has from the beginning been toward amalgamation. This is apparent to all, and is popularly termed the growth of monopoly. The facts that have herein been presented all tend to illustrate the truth that this amalgamation has been accompanied by as constant a reduction of rates. The so-called "monopoly" is thus shown to be exactly the opposite of those privileged corporations which, in the past centuries, have given the word its evil significance : for, without any special or exclusive privilege, the railroad is in itself an institution which naturally secures whatever monopoly it has of the business of transportation by the superior advantages and cheapness which it affords. With the reduction of rates, therefore, the "monopoly" must increase ; for the reduction of rates means an increase of traffic.

The reduction of rates, however much it may be influenced by the competition of parallel lines, is absolutely controlled by the operation of those great natural laws which govern all commercial transactions. These laws are summed up in the statement, made some years since by the President of the Central Pacific Railroad Company, that "the interests of the railroad and the community are identical." The prosperity of the former is absolutely dependent upon the prosperity of the latter ; and the development of the industries and the increase of the products of the communities depend upon cheap transportation, perhaps more than upon any single thing. It becomes, therefore, not only the interest of the railroads to furnish cheap transportation, but they are led also to the same action in their efforts to increase their net income. As the ratio of expenses decreases with the increase of traffic, a reduction of rates which secures an increase of traffic thus produces an increase of net profit. Consolidations, by reducing the ratio of expenses, make possible the greater reduction of rates ; and

great corporations, having their interest connected with wider and more extended territory, have broader views in their management, and are guided by policies which tend more to the healthful and permanent development of their properties and the territories which they depend upon for their revenue. The facts, in America as well as in Europe, fully confirm the statement of the Parliamentary Committee of Great Britain, that amalgamations result in furnishing better service, lower rates, and higher dividends—a benefit to all alike.

In the popular mind, the solution of the railroad problem is based upon the fundamental misconception that the so-called railroad "monopolies" raise the tariffs at their pleasure, are controlled only by their own wills, and so, influenced alone by selfish interests, they maintain unreasonably high or extortionate rates. Yet, it will always be found that, in seeking to advance their own interests, they are absolutely controlled by those general economic laws through the operation of which every one is seeking his own good, under terms as nearly equal as is allowed by nature itself; and their interests can only be advanced by advancing also the interests of their patrons. Freight will only be shipped when its transportation results in a profit to the shipper. The greater this profit, or the more it is extended to all articles of trade, the greater is the traffic; and the greater the traffic of the railroads, the greater is their profit. Under the operation of natural laws, each, in seeking its own interests, must advance also the interests of the other; this result can only be changed when the laws of nature are suspended by the legislation of man.

The railroad, heretofore generally untrammeled by restrictive legislation, has been productive of more beneficent results to the country at large than the most sanguine enthusiast of a generation ago would have dreamed. As it is a human institution, it has contained also the faults common to humanity. These, experience and interest will in time reduce to a minimum; and, guided by the same laws which in the past have produced so favorable results, its future operations must constantly work toward the greatest good of the greatest number.

QUEER PHASES OF ANIMAL LIFE.*

By FELIX L. OSWALD, M. D.

OUR nearest relatives in the large family of the animal kingdom are undoubtedly the frugivorous four-handers, with some of their nocturnal congeners, but it would be difficult to classify the quadru-

* This article is made up from the text of Oswald's "Zoölogical Sketches" (noticed in our pages last month), by permission of the publishers of the volume, Messrs. J. B. Lippincott & Co., of Philadelphia, to whose courtesy we are also indebted for the accompanying illustrations.—Eds. P. S. M.

mana after the degree of that relationship: no naturalist could name the most man-like ape. It is a *reticulated* rather than a graduated system of affinity, as Carl Vogt expresses it; the type of the human form is a center from which the connecting lines diverge in various directions. To every supposed characteristic of our physical structure some genus or other of the multiform family has been found to exhibit a parallel; only the combination of these attributes distinguishes man from all monkeys.

The Latin word *simia* is derived from *simus* (flat-nosed), and Ælian considered the prominence of the human nose as a prerogative of our species; but Sir Stamford Raffles discovered a nose-ape, the Bornean representative of the genus *Semnopithecus*, a big, long-tailed brute, with a truly Roman proboscis and the narrow nostrils of the Caucasian race. In proportion to his size, the white-handed capuchin-monkey of Western Guiana has a higher forehead than the two-legged inhabitants of his native woods; and the anatomist Camper demonstrated that, with respect to the length of the tail-bones, immortal man forms the connecting link between the lower apes and the orangs. The Arabs, who question the human pedigree of the beardless Ethiopian, would have to hail the wonderoo as a man and a brother; and the male orang-outang, too, can boast of a chin-tuft that would do credit to a modern senator.

It would, indeed, be a mistake to suppose that all monkeys are naturally mischievous. The little Tamarin (*Midas rosalia*) handles its playthings more carefully than most children, and the females, especially, seem almost afraid to stir without their keeper's permission. Gratuitous destructiveness is rather a distinctive trait of the African quadrumana, and their representative in this respect is, perhaps, the *Cercopithecus maurus*, the Moor-monkey, or *monasso*, as they call him in Spain, a fellow who seems to consecrate his temporal existence to mischief with an undivided and disinterested devotion. This maurus and his cousin, the rock-baboon, are the terror of the Algerian farmer; but the baboon contents himself with filling his belly, while the other tears off twenty ears of corn for one he eats, and often enters a fig-garden for the exclusive purpose of stripping the trees of their leaves and unripe fruit. In captivity he can not be trusted even with a leather jacket, and, finding nothing else to spoil, does not hesitate to exercise his talent upon his younger relatives, to the detriment of their woolly fur. Still, his intelligence and restless activity make him a prime favorite of the fun-loving Spanish sailors, and in the Andalusian seaports every larger household has a monasso or two—*monos de cadena*, "chain-monkeys," as the dealers call them, a Moor-monkey and a *cadena* being as necessary concomitants in civilized regions as a king and a constitution. A rupture of the concatenation creates an alarm, as if the chained beast of the Apocalypse had broken loose, and, if an unchained monasso gets a five minutes' chance at a kitchen or a parlor,

he can be relied upon to commit all the havoc a creature of his strength could possibly execute in five times sixty seconds; an instinct bordering on inspiration seems to tell him at the first glance where and how to perpetrate the greatest amount of actual damage in the shortest possible time. In a harbor-hotel of Cartagena I saw a mono whose terpsichorean talents had made him a more than local celebrity. He could dance the Moorish *zameca*, besides the bolero and fandango, and was sometimes released at the request of his admirers, who pitied his constant collisions with the lock of his drag-chain; but on such occasions the landlady used to charge a *real* extra, for even her presence did not prevent the mono from indulging his ruling passion. Under pretext of returning the caresses of his visitors, he managed to abstract their buttons, upset a flower-pot or two, or interrupted his performances to make a grab at a litter of poodle puppies on the veranda. His scar-covered skull proved that the lot of the transgressor is hard; but the

FIG. 1.—TOTAL DEPRAVITY.

depilated condition of his neck was owing to a peculiar trick of his, as the *posadera* explained it. He would hug a post near his couch under the veranda, and, stretching his head back and his tongue out, would twist his neck to and fro, as if in the agonies of strangulation.

During a temporary absence of their mother he once succeeded in deceiving the children by these symptoms of distress; they loosened his chain-strap an inch or two, but happily took the precaution to shut the house-door and the cellar-gate. But they had forgotten the poultry-house; and when the lady returned in the evening her sixteen hens had been converted into Platonic *homunculi*—"bipeds without feathers and without the power of volitation." On another occasion he came near setting the house on fire by drenching the cat with the contents of a large kitchen-lamp. Still, after trying sundry other four-handers, the lady declined to part with her monasso, though she lamented his utter want of principle, like the *Devin du Village:*

"Hélas! que les plus coupables
Toujours sont les plus aimables!"

The anthropoid apes are a somewhat taciturn race, but a chimpanzee's murmur of affection is very expressive, and quite different from his grunt of discontent. A sick orang-outang sheds tears, moans piteously, or cries like a pettish child; but such symptoms are rather deceptive, for the orang, as well as the chimpanzee, is a great mimic, not of men only, but of passions and pathological conditions. Two years ago I took temporary charge of a young chimpanzee who was awaiting shipment to the Pacific coast. His former landlord seemed to have indulged him in a *penchant* for rummaging boxes and coffers, for whenever I attempted to circumscribe the limits of that pastime my boarder tried to bring down the house, metaphorically and literally, by throwing himself upon the floor and tugging violently at the curtains and bell-ropes. If that failed to soften my heart, Pansy became sick. With groans and sobs he would lie down in a corner, preparing to shed the mortal coil, and adjusting the pathos of the closing scene to the degree of my obstinacy. One day he had set his heart upon exploring the letter department of my chest of drawers, and, after driving him off several times, I locked the door and pocketed the key. Pansy did not suspect the full meaning of my act till he had pulled at the knobs and squinted through the key-hole, but, when he realized the truth, life ceased to be worth living: he collapsed at once, and had hardly strength enough left to drag himself to the stove. There he lay, bemoaning his untimely fate, and stretching his legs as if the *rigor mortis* had already overcome his lower extremities. Ten minutes later his supper was brought in, and I directed the boy to leave the basket behind the stove, in full sight of my guest. But Pansy's eyes assumed a far-off expression; earth had lost its charm; the inhumanity of man to man had made him sick of this vale of tears. Meaning to try him, I accompanied the boy to the staircase, and the victim of my cruelty gave me a parting look of intense reproach as I left the room. But, stealing back on tiptoe, we managed to come upon him unawares, and Pansy looked rather sheepish when we caught him in the act of enjoying an excellent meal.

In Hindostan monkeys enjoy all the privileges of a Mohammedan lunatic, being permitted to rob the orchards with impunity, decimate the rice-crop, and rob all the birds'-nests they want; but, not content with levying out-door contributions, they pillage the cottages of the natives while the proprieters are at work in the fields; nay, they often manage to despoil the larder of the foreign residents, or black-mail their children if they leave the bungalow with a lunch-basket or a pocketful of nuts.

The Rev. George Thielmann, of the Moravian mission, who passed several years in the Eastern Punjaub, describes the despair of his German cook at the impudence of the light-fingered gentry. "I do not see how the natives can stand it," said she; "if they take those baboons for Christians, they ought to have a penitentiary in every village." If she went to the door to answer a bell, the macaques entered the kitchen through the rear window; going to look after her sun-dried peaches, she found that the Bhunder apes had been beforehand with her; and if she left her bedroom-window open she was awakened

FIG. 2.—MISPLACED CONFIDENCE.

by a committee of Honumans taking an inventory of her wardrobe. One day she left the gardener's dinner under a tree where he used to take his *siesta*, but, returning with a dessert of German doughnuts, she was just in time to see a troop of Rhesus baboons running off with the dishes and bottles.

From the moment that a young monkey is weaned he has to steal,

for Dr. Brehm's observation applies strictly and literally to every species of quadrumana; the mother-monkey robs her own child, and forces it to eat its food by stealth. The proprietor of the "Zoölogical Coffee-Garden," in Savannah, Georgia, has been very successful in rearing young monkeys, and the visitors of his happy-family department can witness the same scene thrice a day—a number of half-grown capuchin babies fleeing from the wrath of their own parents. As soon as the dinner-bucket is brought in, the youngsters hide in the corner and watch their opportunity, for while their seniors are feeding there is no hope of a crumb or a drop of milk; but sooner or later the old ones are sure to fall out, and during a general scrimmage for a tidbit the children sometimes get a chance at the bucket, and take care to make the best of it. But woe unto them if their progenitors catch them *in flagranti!* Sires, mothers, and aunts combine to avenge the sacrilege, and the noise of the punishment often sets the whole menagerie agog. I have seen a she-macaque jamming her bantling up against the wall and extracting from its cheek-pouches the gifts of a charitable visitor, together with all the crumbs and scraps the little one had gleaned from the floor, and then adding outrage to injury by cuffing the victim's ears.

The English word stalwart is derived from *stael-worth*—i. e., *worth stealing;* and the same criterion seems to be a monkey's standard for the value of earthly things in general. Any novel, movable, and portable object at once excites his interest. If the digestible qualities of the novelty seem doubtful, he appears to act on the principle that in the mean while it can do no harm to appropriate it. North of the Rio Grande most capuchin-monkeys are martyrs to rheumatism, and three poor cripples of the Cebidæ species had been assigned winter-quarters in the kitchen of a New Orleans boarding-house. They could be trusted, as their complex ailments disqualified them from running and climbing, their only mode of progression being a sidelong wriggling on their haunches and elbows. But one day the landlady heard a frightful caterwauling, and, entering the kitchen in haste, was surprised to see one of her patients on top of the chimney-ladder, while another was rolling about in a fit of fantastic contortions. The cook had left on the floor a bucketful of Pontchartrain crabs, and during her momentary absence the monkeys had fallen victims to the cause of free inquiry. Somehow or other the cook's manœuvres had drawn their attention to the bucket, and, having managed to upset it, their ring-tails had got entangled with the not less prehensile crustaceans.

The tardo (black sloth) has a peculiar talent for making himself invisible. Even a medium-sized tree, without an excessive supplement of tangle-vines, has to be inspected thoroughly and from different points of view before a slight movement in the upper branches attracts your attention to a fluffy-looking clump, not easy to distinguish from

the dark-colored clusters of the feather-mistletoe (*Viscum rubrum*) which frequents the tree-tops of this mountain-region. Closely resembling clusters of feathery leaves and feathery hair are often seen side by side on the same branch. Which of them is the animated one? A load of buckshot may fail to settle the point. I have seen a troop of

Fig. 3.—Martyrs to Free Inquiry.

idle soldiers bombarding a sloth-tree for half an hour with the heaviest available missiles without being able to force the *stronghold* of the occupant, who only tightened his grip when a well-aimed stone crushed his head visibly and audibly. But with a good rifle you may dislodge the most tenacious tardo by hitting his branch somewhere below his foot-hold, for a fractured caucho-stick will snap like a cabbage-stalk. Thus displanted, the falling sloth clutches at the empty air or snaps off twig after twig in his headlong descent, but generally manages to fetch up on one of the stout lower branches, and at once hugs it with all the energy of his prehensile organs; and there he hangs, within easy reach of your arm, perhaps, but without betraying the slightest concern at your approach. The human voice has no terrors for the stoic tardigrade; menacing gestures fail to impress him. A blank cartridge exploded under his nose will hardly make him wink, unless the powder

should singe his eyelids. He permits you to lift his claw, but drops it as soon as you withdraw your hand. If you prod him, he breaks forth in a moan that seems to express a lament over the painfulness of earthly affairs in general rather than resentment of your particular act. By-and-by his love of caloric may lure him back to the sunny side of the tree, but no incentives *a tergo* will accelerate his movements. His claws are a quarter of a foot long and rigidly tenacious, and, once unhooked, he forthwith transfers his attachment to your own person. After spreading his talons fan-shape, he clasps your arm with an intimacy that seems intended to reassure you of his peaceful intentions, but will gradually draw himself well up, as if unwilling to interfere with your locomotive facilities.

But, as Stanislaus Augustus said from sad experience, "Innocence is no excuse before the tribunal of war," and, in the tropics at least, a state of nature is a state of incessant warfare. In spite, therefore, of all his precautions and his monopoly of an almost unlimited food-supply, the sloth is found nowhere in great numbers; his enemies are too many for a creature that can neither fight nor fly. The harpy-

FIG. 4.—A NEW DEPARTURE.

eagle skims the tree-tops of the *tierra caliente*, or falls upon him like a flash from the clouds; the lynx lurks in the twilight of the shade-trees; the sneaking ocelot explores the inmost penetralia of the liana-maze; if he meets him, he meets his death. Carnivora have to combine caution with sudden swiftness to catch a monkey in day-time, but sloth-hunting is a search rather than a chase; small palm-cats or slug-

gish bears may take a morning ramble through the branches of his chosen tree, and, if they espy the poor leaf-eater, his capture follows as a matter of course; they need not pursue him, they can collar him at their leisure; a hungry bear collects a family of sloths as he would gather a bunch of grapes.

Still, Fate has granted the much-bereft edentate one compensation —a cheap one, indeed, but still an offset to many defects—a most contented disposition. On the morning of an unusually cold April day I was summoned to a neighboring town, and took a look at my tool-house menagerie before I left. Finding that the female sloth had monopolized the family couch, I carried her mate up to an empty garret, and attached his claws to a mantel-piece, where he could warm himself by putting his back against a flue of a hot-air chamber. An unexpected delay prevented my return that night, and when I got home the next morning I entered the garret with sore misgivings about the survival of my tardo. But, no; there he hung, on the very same spot and in the same attitude, imbibing caloric at every pore, and purring to himself in dreamy beatitude—a tardo temporarily satisfied that life was worth living.

A striking contrast to the sluggishness of the sloth is presented by Dr. Oswald's description, in another part of the book, of the Honuman monkey at play.

Without wings, agility could hardly go farther; from the standpoint of a practical anatomist, it is almost inconceivable how muscles and sinews, apparently so very similar to our own, can execute such movements. Without the least visible effort, the marvelous half-bird darts through the air in a wide zigzag, merely touching a branch here and there; upward suddenly with a series of mighty swings, regardless and apparently forgetful of obstacles; down with a gradationed spring that looks like a single leap; up again with a flying rebound through a tangle-work of branches, yet at the same time watching his comrades, aiming and parrying slaps or dodging a shower of missiles; then, with a sudden grab, a quick contraction of the hind-legs, and the acrobat sits motionless on a projecting branch, watching a movement in the grass that has not escaped his eye during his headlong evolutions.

A bat is a living anachronism; there is something obsolete and paradoxical in every part of its organization. Skin wings were quite in vogue in the days of the Devonian monster-period, but have gone out of fashion among the representative creatures of our latter-day world; and it is a curious fact that all winged mammals have become nocturnal, as if they could not compete with the talents of their daylight contemporaries. The winged lemur (*Galeopithecus volans*), the flying-fox, and the flying-squirrel, are all moonshiners, and dread sun-

light as miracle-mongers dread the light of science; but they all have the exaggerated optics of an owl, evening-eyes, that catch every ray of the fading twilight, while the eyes of the bat proper are as rudimentary as those of a mole, or of the strange fishes that were discharged from the subterranean tarns of Mount Cotopaxi.

As the Euclidean *punctum* is defined as a point without extension, the voice of a bat might be called a sound without vibrations—a shrill, sudden squeak, unlike any other sound in nature or art. Though piercing enough to be heard from afar, it is too abrupt to guide the ear in any special direction; you can put a wood-bat in a narrow box, and the box on the table, and bet large odds that the incessant shrieks of the captive will not betray its hiding-place; to nine persons out of ten the sound will seem to come from all parts of the room at once.

Many of their habits, too, distinguish the cheiropters from all other creatures of our planet. Aristotle classed them with the birds; and in one respect they might even be considered the representatives of the class, being *par excellence* creatures of the air. All winged insects can run or hop; the sea-gull runs, swims, and dives; but, with the sole exception of the Javanese roussette, bats are completely "at sea" in the water, and almost helpless on *terra firma;* they eat, drink, and court their mates on the wing, and the *Nycteris Thebaïca* even carries her young on her nightly excursions. Nay, bats may be said to sleep in the air, for they build neither day-nests nor winter-quarters, but hang by the thumb-nail, touching their support only with the point of a sharp hook. But this hand-hook connects with muscles of amazing tenacity. In cold climates, where bats have to club together for mutual warmth, fifty or sixty of them have been found in one bundle, representing an aggregate weight of about fifteen pounds, all supported by one thumb-nail! The "head-centers" must sleep as warm as a child in a feather-bed; but it is hard to understand how the outsiders can survive the cold season, for, in spite of its voracity, the bat accumulates no fat, and the flying-membrane is a poor protection against a North American winter. The only explanation is that their winter torpor is a trance, a protracted catalepsy, rather than a sleep; hibernating bears and dormice get wide awake at a minute's notice, but I have handled bats that might have been skinned without betraying a sign of life, and needed more than the warmth of my hands to revive them, for their wings were quite brittle with rigid frost. Bats prefer a cave with tortuous ramifications that shelter them against direct draughts, but still with a wide though not too visible opening, as they do not like to squeeze themselves through narrow clefts. A dormitory combining these requisites is sure to attract lodgers from far and near; the northern entrance of the tunnel-grotto of Posilippo and the Biels-Höhle in the Hartz are tenanted by hundreds of thousands of bats that avoid all the neighboring cav-

erns; and our Mammoth Cave, with its countless grottoes, has only two bat-holes, whose occupants have never been known to change their quarters.

Fig. 5.—Children of Erebus.

Nearly all the South Asiatic vegetarians treat mischievous animals with a more than Christian forbearance; but the worshipers of Brahma have, besides, been taught to regard certain species of the brute creation as half divine, and consequently altogether inviolate, and entitled to the active charity of every true believer—the most privileged of the zoölogical demi-gods being the bhunder-baboon (*Papio Rhesus*), the Honuman (*Semnopithecus entellus*), the Brahmin cow, the pigeon, and the common crocodile. In Hindostan the public spirit of wealthy philanthropists rarely rises above the orthodox conservatism of the national mind; bequests are not devoted to public improvements, but rather to the maintenance in *statu quo* of incor-

porated societies and multitudes of secular and clerical mendicants; and Sir Emerson Tennent estimates that the produce of fully ten per cent of all the stipends of a most charitable population of one hundred and sixty millions is consecrated to the support of lazy or mischievous brutes.

Like Italian lazzaroni, city baboons live in cliques—clannish communities, very exclusive in times of scarcity, and always rather dis-

FIG. 6.—FOUR-HANDED LAZZARONI.

inclined to enlarge their membership except by natural increase and advantageous alliances, as with fat house-baboons with a roving disposition. Four-handed vagrants are promptly stopped and cross-examined: no mercy for the homeless stranger suspected of speculating upon a share of their scanty sportules, while the household

pet with his brass collar and sleek pouch is merely scrutinized with silent envy. The half-grown bhunder-monkeys are so pretty that they are often domesticated, but their relatives dislike to part with them—from motives that have nothing to do with "philoprogenitiveness."

The holy children are their mediators, their apple and bread winners. The entreaties of the little beggars are not easy to resist: they will climb you after the manner of pet squirrels, embrace you with one arm and beg with the other, accompanying their gestures with a deprecatory mumble that becomes strangely expressive, as if they were pleading extenuating circumstances, if you offer to strike them. Even the idol-hating Mussulman is thus often beguiled into a liberality which his conscience may be far from approving. If the little spongers have struck a bonanza, they swallow *in situ* all they can find room for, well knowing that upon their return the contents of their cheek-pouches will be claimed by their relatives, for even a mother-monkey has no hesitation in plundering her own child in that way. To avoid coercive measures, the poor kids surrender their savings voluntarily and with great dispatch at the approach of the ruthless parent. Like our artist-mendicants who keep a beggar-boy *ad captandum*, old baboons sometimes kidnap a baby of another tribe, keep a strict watch on its movements, but urge it with slaps and grunts to work the passers-by. Crippled baboons, too, are a most welcome acquisition to any clique. These twice-worthy objects of charity have their regular headquarters, where they can be found at any time of the day surrounded by eupeptic relatives who hope to participate in the largess of the pious. The poorest huckster will stop his cart in a gate-way to hand his tribute to a decrepit bhunder-monkey who supplicates him with outstretched hands. No true believer must stint his gifts upon such occasions; and so well does the hairy mendicant know the stringency of that duty that he flies out into a paroxysm of virtuous wrath if any passer-by should dare to disregard his appeal. The relatives promptly yield their aid, and fruit-carts are in danger of being monkey-mobbed if the driver hesitates to propitiate their resentment by a liberal contribution.

In a sparsely settled but tolerably fertile country animal refugees soon accustom themselves to the vicissitudes of their wild life. The ten months' drought of 1877, which almost exterminated the domestic cattle of Southern Brazil, was braved by the pampa cows, whom experience had taught to derive their water-supply from bulbous roots, cactus-leaves, and excavations in the moist river-sand. Solid food is only a secondary requirement; with a good supply of drinking-water many animals would beat Dr. Tanner's time. But how the Syrian Khamr dogs manage to make out a living only the gods of the desert know. They rough it in regions where no human hunter would discover a trace of game, and where water is as scarce

as in the eternal abode of Dives; nay, they multiply, for the Khamr bitch, like other poor mothers, is generally overblessed with progeny; six youngsters a year is said to be the minimum. A sausage-maker would probably decline to invest in Khamr dogs; the word *leanness* does not begin to describe their physical condition; *strappedness* would be more to the purpose, if an Arkansas adjective admits of

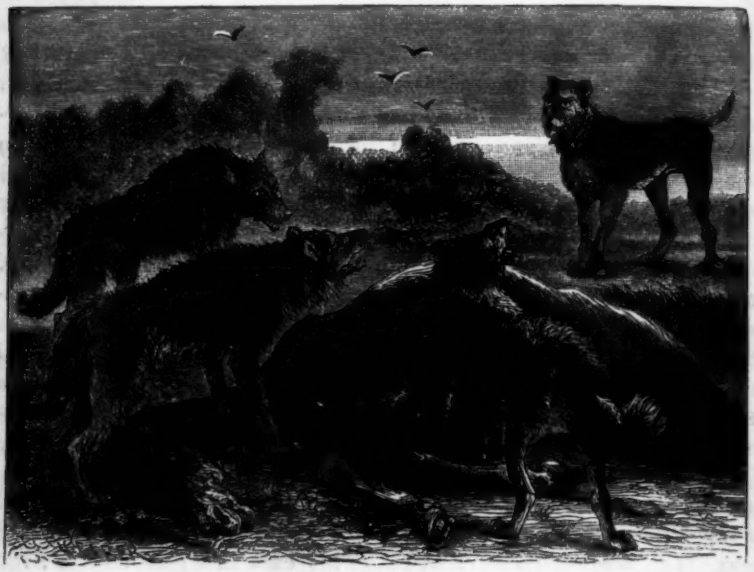


FIG. 7.—WILD DOGS.

that suffix—skin and sinews tightly strapped over a frame-work of bones. I saw their relatives in Dalmatia, and often wondered that they did not rattle when they ran; but Dalmatia is still a country of vineyards and sand-rabbits, while the Syrian desert has ceased to produce thorn-berries. Without moisture not even a curse can bear fruit.

Where food is plenty, wind and weather seem to modify the *physique* of a tramp animal. Most wild dogs are bushy-tailed, gaunt, and fox-headed, and for some occult reason almost invariably *black-muzzled*. It is their clan-mark: judging from the snout alone, few naturalists would be able to distinguish a tramp-dog from the pampa cur, the Khamr hound, the dog-wolf (*Canis anthus*), or the Abu Hossein (*Canis lupaster*). It does not improve their appearance; in connection with their wolfish eyes, it reminds one too much of a hyena-head.

The question whether there are any *untamable* animals requires a nearer definition of the somewhat ambiguous adjective. Untamable, in the sense of undomesticable, I believe there are none. With the proviso of a guarantee against socage-duty or a change of their natural habits, few animals would decline the hospitality of the *homo sapiens*,

especially in countries where the sapient one has become the monopolist of all the good things of this earth. Let any one sweep the snow from his balcony, scatter the cleared space with crumbs, and put the balcony-key where the children can not find it, and see how soon his place will become the resort of feathered guests—not of town-sparrows only, but of linnets, titmice, and other birds that are rarely seen out of the woods. A little discretion will soon encourage them to enter the window and fetch their lunch from the breakfast-table—by-and-by even in the presence of their host—for the fear of men is a factitious instinct, unsupported by the elder intuition that teaches animals to distinguish a frugivorous creature from a beast of prey. With so simple a contrivance as a wooden box with a round hole, starlings, blackbirds, martins, crows, jays, and even owls, can be induced to rear their young under the roof of a human habitation; squirrels, hedgehogs, and raccoons soon find out a place where they can get an occasional snack without having to pay with their hides. Hamman, the famous German skeptic, used to feed a swarm of sea-gulls, often the only visitors to his lonely cottage on the shore of the Baltic. The neighbors suspected him of necromantic tricks, but he assured them that his whole secret consisted in never interfering with his guests—keeping a free lunch on hand, and letting them take their own time and way about eating it.

The same magic had probably bewitched the pets of Miss Meiringer, the daughter of a German colonist of New Freyburg, Brazil. Her father was a self-taught naturalist, and his collections have been described by several South American travelers; but in the opinion of the natives his curiosity-shop was eclipsed by the menagerie of his daughter, who had tamed some of the wildest denizens of the forest, though evidently on the *suaviter in modo* plan, since most of her pets boarded themselves, or only took an occasional breakfast at the *fazenda*. Among her more regular guests were a couple of red coaties, or nose-bears, several bush-snakes, and one large boa, a formidable-looking monster with the disposition of a lap-dog, for at a signal from his benefactress he would try to curl himself up in her apron, with a supernumerary coil or two around her knees.

There is hardly any doubt that animals must possess some means of communicating their ideas. Arsenic has no perceptible taste or odor, and an ounce of it mixed with a bushel of corn-meal will destroy a cart-load of sewer-rats in a single day; but all professional vermin-killers agree that such receipts lose their efficacy in a very short time. Somehow or other the survivors manage to trace the mischief to its cause; and old rats have been observed in the act of driving their young from a dish of poisoned hash. When the British first effected a settlement in Singapore, the traffic in monkeys soon became a regular branch of industry. The ubiquitous Chinamen used to go on trap-

FIG. 8.—STRANGE MESSMATES.

ping expeditions to the hills, at a time of the year when the mountain macaques were rather hard up for provisions and could be baited with "fuddle-cakes"—i. e., rice-bread soaked in a mixture of sugar-and-rum. The trapper used to hide behind a tree, and let the monkey assemblage enjoy his bounty till their antics suggested that it was time for him to rush in, like Cyrus into the banquet-hall of Belshazzar. Experience, however, soon taught the little mountaineers to change their tactics. Instead of devouring the fuddle-cakes on the spot, they learned to gather them up and defer the feast till they reached a retreat where they could hope to be left alone in their glory. But the trappers, too, have since changed their plan. They manufacture a sort of narrow-necked jars, about the size of sarsaparilla bottles, and, after filling them with a *mélange* of sirup and alcohol, they tie them firmly to the root of a tree and withdraw out of sight. The monkeys come down and sip the nectar, a little at a time, till many a mickle has muddled their perceptives to the degree which the founder of Buddhism would have called the first stage of *Nirvana*—indifference to earthly concernments in general. The trapper then approaches and collects his guests, whose

exalted feelings often manifest themselves in a peculiar way. Some receive their captor with open arms, some hug their bottles with ap-

FIG. 9.—THE WAGES OF SIN.

probative grunts, while others lie on the ground, contemplating the sky in ecstatic silence.

Practical naturalists are generally the most successful trappers, for Lord Bacon is probably right, that observation is quite as prolific a mother of inventions as necessity. Only observation could have revealed the fact that little song-birds can be attracted by the sight of a bird of prey. A common chicken-hawk will serve that purpose. Fasten a tame hawk to a bush, and before the end of an hour all the finches and thrushes in the township will find it out and meet in general convention—an indignation-meeting, perhaps—though it is hard to understand what they can hope to accomplish against an enemy who could kill a score of them in ten minutes. But the experiment never fails: a hawk, an eagle, but especially a ferocious-looking old horn-owl, will allure birds at a time when they would disdain to neglect their domestic business for the sake of any tidbit. An owl-riot they seem to consider as a sort of public duty which must take precedence

of all other affairs, for even migratory birds will stoop from their flight through air and light to screech around an old night-spectre. In Northern Italy, where game is scarce, every farmer has a tame *buba*

FIG. 10.—DECOY OWLS.

and a potful of bird-lime, and thousands of northern songsters, hastening fondly home from their winter-quarters on the Mediterranean, fall a victim to their ruling passion and perish in exile—"butchered to make a Roman holiday."

"NATURAL RELIGION."

A STUDY IN THE GROWTH OF SCIENTIFIC MORALITY.

By R. W. BOODLE.

II.

THE preliminary discussion of last month enables us to speak now more directly of the work on "Natural Religion." Its writer is clearly himself a believer in supernaturalism, if not as very tangible, yet as an underlying possibility. He begins by stating the prob-

lem before us: "Two opposite theories of the universe are in conflict. On the one side is the greatest of all affirmations, on the other the most fatal of all negations. There never yet was a controversy which was not trivial in comparison with this. It is cruel trifling to speak of compromise, it is waste of time to draw verbal distinctions." And then, after two hundred pages of verbal distinctions, many of which are really no better, a compromise is effected upon the basis of natural religion, which is also natural Christianity without its supernaturalism. But the writer has no wish to deceive either himself or his readers, and concludes, "Who will not say that a supernatural religion, supplementing a natural one, may be precious, *nay, perhaps indispensable?*" And indispensable he shows it to be, from his own point of view: "When the supernatural does not come in to overwhelm the natural and turn life upside down, when it is admitted that religion deals in the first instance with the known and the natural, then we may well begin to doubt whether the known and the natural can suffice for human life. No sooner do we try to think so, than pessimism raises its head. . . . A moral paralysis creeps upon us. . . . Supernatural Religion met this want by connecting Love and Righteousness with eternity. If it is shaken, how shall its place be supplied? And what would Natural Religion avail then?" We have, then, to remember that this attempt to establish a harmony between orthodoxy and the votaries of art and science, upon the minimum basis of a faith without a personal God and without miracles, is a compromise honestly offered by one who himself apparently still cherishes these beliefs. It is a fair attempt to arrive at some understanding by sinking out of sight the points upon which people differ, and by bringing into prominence their points of agreement.

As I suppose that most of my readers have either read this book or intend to do so, anything like a full account of its contents here will be unnecessary. It will not, however, be out of place to attempt a slight sketch of its general argument and conclusions. Our author begins by pointing to the divinity of nature as the common ground between Christianity and science. The real issue is not between theism and atheism, for science is in a very real sense a theology, and believers in nature have many of the feelings of Christians for their deity. Thus, we have a natural theology; it will widen into a natural religion, when the science of the relation of the universe to human ideals has grown up; and this science, upon a purely natural basis, is fast constructing itself. Defining worship as "habitual and permanent admiration," he sees nothing to fear in the gospels of art and humanity. Just as the gospel of science is an allotropic form of mediæval theology, so is the gospel of art the revival of Greek paganism under altered conditions, and the gospel of humanity that of Christianity. Each is, to some individuals, a faith in itself, because it lifts them above mere materialism, above conventionalism, above the ordi-

nary run of men; in short, above what our author calls, boldly, atheism. "An atheist, in the proper sense of the word," he writes, "is not a man who disbelieves in the goodness of God, or in His distinctness from Nature, or in His personality. These disbeliefs may be as serious in their way as atheism, but they are different. Atheism is a disbelief in the *existence* of God—that is, a disbelief in *any* regularity in the Universe to which a man must conform himself under penalties." The religion of the future must combine all three worships. In the individual the results will be practically equivalent to culture, in the aggregate to civilization. The ideal of antiquity was one of separate nationalities, with separate religions; the ideal of the middle ages was an imperial state and a catholic church. The two ideals will be combined in the church and state of the future. The writer points out very clearly the connection between the spirit of nationality and the spirit of religion. The church of the future will be missionary, carrying its faith into uncivilized Asia and Africa; it will be undogmatic, it may even be without a temple, but it will not be without worship, for we have objects for this in nature on its various sides. He thus takes occasion to correct a very common misconception with regard to nature:

"It is often said that, when you substitute Nature for God, you take a thing heartless and pitiless instead of love and goodness. Undoubtedly much less of love and goodness can be discovered in Nature than Christians see in God. But when it is said that there are no such qualities in Nature, that Nature consists of relentless and ruthless laws, that Nature knows nothing of forgiveness, and inexorably exacts the utmost penalty for every transgression, a confusion is made between two different meanings which may be given to the word Nature. We are concerned here with Nature as opposed to that which is above Nature, not with Nature as opposed to man. We use it as a name comprehending all the uniform laws of the Universe as known in our experience, and excluding such laws as are inferred from experiences so exceptional and isolated as to be difficult of verification. In this sense Nature is not heartless or unrelenting; to say so would be equivalent to saying that pity and forgiveness are in all cases supernatural. It may be true that the law of gravitation is quite pitiless, that it will destroy the most innocent and amiable person with as little hesitation as the wrong-doer. But there are other laws which are not pitiless. There are laws under which human beings form themselves into communities, and set up courts in which the claims of individuals are weighed with careful skill. There are laws under which churches and philanthropical societies are formed, under which misery is sought out and relieved, and every evil that can be discovered in the world is redressed. Nature, in the sense in which we are now using the word, includes humanity, and therefore, so far from being pitiless, includes all the pity that belongs to the whole human fam-

ily, and all the pity that they have accumulated and, as it were, capitalized in institutions, political, social, and ecclesiastical, through countless generations" (pp. 65, 66).

The writer thus looks upon natural theology as the "true deduction of the laws that govern the universe," as the "science of the relation of the universe to human ideals," and the following are some of the questions that it has to answer: "Is there a reward for virtue? Is there a compensation for undeserved misery? Is there a sure retribution for crime? . . . In one word, is life worth having, and the Universe a habitable place for one in whom the sense of duty has been awakened?" (p. 61). On the other hand, natural religion is "worship of whatever in the known Universe appears worthy of worship," it "is no mere dull morality, for in the first place it is far wider than any morality, being as wide as modern culture, and in the second place, so far as it is moral and bears fruit in morality, even here it is no mere morality, but an historic religion of humanity" (p. 172). It is "the principle by which alone life is redeemed from secularity and animalism." "Thus, instead of saying that the substance of religion is morality, and the effect of it moral goodness, we lay it down that the substance of religion is culture, and the fruit of it the higher life" (p. 138).

The strong point of such a system as this lies in its fully recognizing the facts of spiritual development that the review of the past thirty years reveals, viz.: that the religion of the churches is but one among other religions of the present day; that the work, heretofore done by religion, in raising the general tone of life, is now really being accomplished by the separate influences that are summed up in what we call *modern civilization*. But along with religion in the old sense went something more. Part of its charm lay in the light it threw on the darkness which encompassed men's lives. "So seems the life of man," said one of the early English converts to Christianity, "as a sparrow's flight through the hall when you are sitting at meat in winter-tide, with the warm fire lighted on the hearth, but the icy rainstorm without. The sparrow flies in at one door, and tarries for a moment in the light and heat of the hearth-fire, and then flying forth from the other vanishes into the wintry darkness whence it came. So tarries for a moment the life of man in our sight, but what is before it, what after it, we know not. If this new teaching tells us aught certainly of these, let us follow it." Thus religion acquired part of its hold on the minds of men by ministering to their growing desire for knowledge. But the completion of knowledge only leads to the realization of our own ignorance, and the gospel of science with regard to the Unknowable is but the echo of the words of Hooker, that "our soundest knowledge is to know that we know him not as indeed he is, neither can know him, and our safest eloquence concerning him is our silence."

The chief objection that any naturalistic scheme of religion has to encounter comes from those who, applying the language of jurisprudence to every-day life, urge that the three terms, *command*, *duty*, and *sanction*, are inseparably connected; that command and duty are correlative terms; that, wherever a duty lies, a command has been signified. Such arguers refuse to recognize in a religion without some supreme will constraining a religion at all. Thus Canon Liddon* calls religion "essentially a relation to a person. . . . Religion consists fundamentally in the practical recognition of a constraining bond between the inward life of man and an unseen Person; . . . the maintenance of a real relation with the personal God, or with a Divine Person really incarnate in Jesus Christ." The same objection appears in a slightly altered form in pages of the London "Spectator," in the course of a discussion upon natural religion, suggested by the work before us:

"We do not differ from this able writer in thinking that there is such a thing as 'natural religion,' but we do differ from him when he asserts there is such a thing for one who declines, or is unable, to discover in the universe traces of a superphysical, we would rather say, than a supernatural, Power—that is, traces of a power to mold and modify that in nature which is physical, in the direction and for the purposes of that in nature which is not physical, but mental and moral. There is no end of 'natural religion' in the mere discovery of human free-will, for that is the discovery that the adamantine chain of physical necessity has been and is interrupted by the will of man itself—a discovery utterly inconsistent with the favorite scientific view. There is no end of 'natural religion' in the discovery of conscience, that there is a moral obligation on us to do this rather than that—an obligation from which it is simply impossible to escape, without bringing on ourselves an unappeasable remorse, and a sense of conscious unworthiness from which it is impossible to dissociate the conviction of invisible condemnation and displeasure. There is no end of natural Christianity in the discovery that Christ is an ideal infinitely and hopelessly above and beyond us, and yet full of power to draw us upward, if we will, toward himself. But there is, to our minds, nothing worthy of the name of natural religion or natural Christianity at all that does not promise us guidance and excite in us trust. . . . The author of 'Ecce Homo' seems to us content to find a natural religion in that which is neither natural nor religious—not natural, because, in spite of the paradox, it is in the highest sense natural to man to lean on something beyond Nature; not religious, because religion means something which is binding, something which we can not in our hearts defy, and we can in our hearts defy any power which only threatens us with extinction, and does not threaten us with inextinguishable remorse."

* "Some Elements of Religion."

We may pass over the first objection to natural religion, viz., that it is not natural, because the argument appears a mere play upon words. Natural religion is called so because it differs from supernatural religion; because it is the religion that is deducible solely from the course of Nature, from the observance of the laws that govern the world in which we live. But it is also objected that the religion inculcated by civilization without supernaturalism is one that is *not binding*, one *which we can in our hearts defy*.

But are virtue, truth, and love less realities in life because we have dissociated from them the mythology in which they were originally bodied forth to the primitive mind—the clothes which were originally wrapped around them? Listen to the eloquent words of a recent writer: "We must *suffer* with Christ whether we *believe* in Him or not. We must suffer for the sin of others as for our own, and in this suffering we find a healing and purifying power and element. This is what gives to Christianity, in its simplest and most unlettered form, its force and life. Sin and suffering for sin; a sacrifice, itself mysterious, offered mysteriously to the Divine Nemesis, or Law of Sin—dread, undefined, unknown, yet sure and irresistible, with the iron necessity of law. . . . Virtue, truth, love, are not mere names; they stand for actual qualities which are well known and recognized among men. These qualities are the elements of an ideal life, of that absolute and perfect life of which our highest culture can catch but a glimpse. As Mr. Hobbes has traced the individual man up to the perfect state, or Civitas, let us work still lower, and trace the individual man from small origins to the position he at present fills. We shall find that he has attained any position of vantage he may occupy by following the laws which our instinct and conscience tell us are Divine."*

Yes! these laws are divine—not because we can see the legislator, not because they were supported in the past by supernaturalism; but because they rest upon our subjective consciousness, supported by science, by poetry, and the history of the life of man upon the earth; because they are vouched for by voices of the wise in all ages, and because they have become part of ourselves. And we have to obey these laws, not because we fear punishment in another world, but because the violation of them is followed by remorse and disaster in this; we have to do right, because it *is* right, because we can only attain the full perfection of our natures by doing so, because humanity will have it so. Mr. Mallock pointed out that, while science has reduced the earth to insignificance, has robbed it of its glory as the center of the universe, and man of his boasted eminence as the special pet of the Creator, still an intense self-consciousness has been developed in the modern world. "During the last few generations man has been curiously changing. Much of his old spontaneity of action has gone from him. He has become a creature looking before and

* "John Inglesant," chapters xxiii, xxxix.

after, and his native hue of resolution has been sicklied over by thought." True, and with this increase of self-consciousness have increased the binding force of the subjective feelings upon which right and wrong depend; we expect more of ourselves, and we expect more of our fellow-men. "Three hundred years before" (I am quoting again from Mr. Shorthouse), "in the child-like unconsciousness of spiritual conflict which the unquestioned rule of Rome for so long produced, it had been possible, in the days of Boccaccio, for cultivated and refined society to shut itself up in some earthly paradise, and, surrounded by horrors and by death, to spend its days in light wit and anecdote, undisturbed in mind, and kept in bodily health by cheerful enjoyment; but the time for such possibilities as these had long gone by." And if this was true of life in the seventeenth century, as compared with the fourteenth, with how much greater force does it apply to life in the nineteenth century!

I will approach the same subject from another point of view. It is possible to allow—in fact, it is impossible to deny—that conscience has not lost its force, notwithstanding the apparent weakening of the supernaturalism to which it has been usual to ascribe its origin and binding force. But the necessity of recognizing some supreme personal will is often urged as a mental necessity, at least as a convenient theory. If the Supreme Being did not exist, it would be necessary to invent him. We can often see our own fallacies in a clearer light by comparing them with modes of thought in the past, now recognized to be no longer sound. And this struck me very forcibly the other day when I was reading Dante's pleading for the maintenance of the supreme power of the emperor in the middle ages. These arguments, I thought, in the "De Monarchia," are exactly the arguments we hear urged every day in favor of the existence of a personal will in the government of the universe. Yet it may be possible that, as society has managed to exist and to improve without the existence of the former, so our moral and religious life will continue practically unaltered without the conscious recognition of the latter. I will illustrate by extracts.

Dante points out what may be called the physical necessity for a single monarch: "Since the whole heaven is regulated with one motion, to wit, that of the *primum mobile*, and by one mover, who is God, in all its parts, movements, and movers (and this human reason readily seizes from science); therefore, if our argument be correct, the human race is at its best state when, both in its movements and in regard to those who move it, it is regulated by a single Prince, as by the single movement of heaven, and by one law, as by a single motion. Therefore, it is evidently necessary for the welfare of the world for there to be a Monarchy, a single Princedom, which men call the Empire." *

* "De Monarchia," Book I, chap. ix.

In the same manner he shows that justice and order depend upon the stability of the imperial power: "Justice is strongest in the world when it is in one who is most willing and most powerful; only the Monarch is this; therefore, only when Justice is in the Monarch is it strongest in the world. . . . All concord depends on unity which is in wills; the human race, when it is at its best, is a kind of concord; for as one man at his best is a kind of concord, and as the like is true of the family, the city, and the kingdom; so is it of the whole human race. Therefore, the human race at its best depends on the unity which is in will. But this can not be unless there be one will to be the single mistress and regulating influence of all the rest. And this can not be unless there is one prince over all, whose will shall be the mistress and regulating influence of all the others. But if all these conclusions be true, as they are, it is necessary for the highest welfare of the human race that there should be a Monarch in the world; and, therefore, Monarchy is necessary for the good of the world." *

It is curious to remark that for a moment Dante seems to have caught sight of the modern point of view in regard to supreme power in the political and religious world. He is arguing against the mediæval symbolism which saw in the sun and moon the types of the two great powers on earth: "Seeing that *these two kinds of power are, in a sense, accidents of men, God would thus appear to have used a perverted order, by producing the accidents before the essence to which they belong existed.*" In the same way we should argue, extending the terms, that before the essential point of government in the political and religious world, viz., order and morality, became distinctly conscious in the minds of men, their accidents, the divine state and the divine Church, came into being. This view, however, he summarily rejects: "It is ridiculous to say this of God. For the two great lights were created on the fourth day, while man was not created till the sixth day, as is evident in the text of Scripture." †

The real secret of the persistence of the supernatural in an age of science is the tacit allowance that "what can not be demonstrated by observation not to exist may be taken as existing for purposes of edification." ‡ For many years to come we shall probably continue to meet in the same communities with what would at first appear to be strange inconsistencies. Thus, at the end of August, Montreal was welcoming with open arms the high-priests of the new faith, the leaders of the American scientific world. Little more than a fortnight afterward, they were expressing their devout gratitude to the Giver of all good for enabling British soldiers to crush the wretched Egyptian, and add to the luster and renown of British arms.# And to those who

* "De Monarchia," Book I, chaps. xi–xv. † Ibid., Book III, chap. iv.

‡ Leslie Stephen.

On September 16th a resolution was passed by a public meeting of the citizens of Montreal, expressing "devoted loyalty to her Majesty's crown and Government," and

have faith in the future of humanity, in the eventual evolution of a verifiable and complete science of life, such a mixture of the strands of religious consciousness will cause no uneasiness. For just as the earliest scientific psychology cheerfully recognized the two sides of the human mind—the rational and the irrational—as equally necessary, equally human, so in an altered sense we may say that the religion of humanity, as it springs from the human heart, must not only take cognizance of its justifiable aspirations, but of those hopes and fears also which in a strict sense of the word we might be tempted to call irrational, as in no sense founded on reason, if not in direct antagonism with it. Yet, we are not, for all that, obliged to postulate an essence above and beyond human reason, as the cause of these emotions and sentiments. Rather, they are the gropings of the human spirit in its efforts—efforts ever to be renewed and ever baffled—to comprehend the Unknowable. "Poor men, most admirable, most pitiable," cries "A Voice from the Nile"—

> ". . . man
> Has fear and hope and fantasy and awe
> And wistful yearnings and unsated loves
> That strain beyond the limits of his life,
> And therefore Gods and Demons, Heaven and Hell;
> This Man, the admirable, the pitiable."

And therefore, we may add, recognizing the fact as fully as the adherents of the old faith, therefore does man differ from the other animals. But none the less are we bound to recognize also that in this special sphere, in religion, whose function it was to raise men above themselves by raising their thoughts to something higher than themselves, the center of gravity, so to speak, has changed. To the ancient mind, the highest truth lay in the region of idea; to the modern mind, in the world of fact. The religion of men in the middle ages was their poetry, their science, their consolation for the ills of life; it made mankind better, but did not consciously aim at making the world a better place to dwell in; their eyes were turned to a resting-place above, for which life on earth was at best a school of discipline. The supposition upon which these beliefs rested, "that our living nature will *continue* after death,"* we can rest upon with confidence no longer—it is at best but an aspiration; and our religion is nothing if it does not aim at the improvement of the world in which we live, if it does not ground itself upon a basis of fact. Yet, even so, the best advice is probably that of the great master of human wisdom, who,

resolving that "we express our devout gratitude to Almighty God, the Giver of all good, for the brilliant successes granted to the British arms in Egypt; that we rejoice that our forces have by their courage and devotion added to the luster and renown which British valor has achieved in all quarters of the globe." The resolutions "were all carried unanimously, amid enthusiastic cheering."

* Butler's "Analogy," conclusion to Part I.

living long years ago before the hubbub of Christian and anti-Christian controversy, exhorted us not to follow the advice of those who bid us tame down our aspirations to our mortal condition, but as far as possible to think the thoughts of immortals, and to live in our every act up to the noblest part within us.*

VIVISECTION AND PRACTICAL MEDICINE.

By G. F. YEO, F. R. C. S.,
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OVER and over again we have been challenged by the opponents of science to give "one conclusive example where experiment has been of direct use to practical medicine." To any one familiar with the history of scientific medicine there can be no difficulty in finding numerous such instances, and, as a matter of fact, many examples have from time to time been given by various writers; but to make these cases satisfactory and conclusive to persons who know but little, and do not care to know more, of the true bearings of the question, is a very difficult matter. Such a test is totally wrong and misleading when applied to the utility of experiment on the lower animals. The matter must be viewed from a wider stand-point than that embracing only single instances of direct benefits accruing from specific experiments.

The primary object of experimental research is to advance physiology—the science which teaches us the uses of the various organs and textures of the body in the normal state, and how the working of the animal economy is carried on in health. The value of physiology depends on the knowledge it gives us of the normal operations of the body, and not on the few cases in which certain experiments happen to aid us in understanding disease, and thus directly promote the practice of the healing art. Our argument is rather this: Physiology is the foundation of both pathology and therapeutics, which together make up medicine; and therefore rational medicine depends directly upon physiology for its strong growth and genuine progress.

Now, physiology can not advance without vivisection; experiment on living animals is as essential to its progress (though far less general in application) as is dissection for the study of anatomy. Therefore, experimental research, including that carried out on living animals, is as necessary for the progress of the practice of medicine as is experimental research in any other science for its advancement and application to daily life. The immediate object of physiological experiment is, then, not to make out new practical methods of treating dis-

* Aristotle's "Nic. Ethics," Book X, chap. vii, § 8.

ease, but rather to attain to a more complete and sound understanding of those general laws which govern the actions of the living body in health—laws which must ever form the only firm basis of the knowledge of disease, and the only sure guide to judicious modes of treatment.

The rational practice of physic, as it is carried on in the present day, is in a great measure the outgrowth of a slowly growing physiological science, upon which it depends, and from which it can not be separated. There is hardly a thought that can strike a practitioner that does not in some way depend upon physiological facts which have been elicited by experimental research. I do not mean to state that the accurate and painstaking observation of clinical facts and *post-mortem* appearances has not done much—probably more than anything else—to bring our medical knowledge to its present stand-point; but I contend that clinical observation and *post-mortem* experience without physiological research would never have been able to advance medicine to the position it holds in modern times; and, on the other hand, I believe that physiological study, even unaided, could arrive at a rational system of treatment. No doubt both clinical study and pathological observation have not only helped practical medicine onward, but they have also greatly contributed to the progress of physiology itself. In fact, I find it impossible to separate exact clinical and pathological work from scientific research of a purely physiological nature. Is not all treatment more or less experiment? And is not this particularly true of purely empirical treatment? Nowadays, where is the pathological laboratory in which a mere record of *post-mortem* changes in the human subject is not aided by experimental inquiry into pathological changes in the lower animals?

In assigning to each department of medical study its due meed of credit, their relative ages must be borne in mind. It has been asserted that all the improvements brought about by experimental research would have been introduced with equal certainty had experiment on living animals never been attempted. Observation, experience, and thought would have attained all the results we now enjoy. Possibly so; but when? Clinical observation can be traced back some three or four thousand years, and even then it started with a rich legacy of traditional knowledge. Experimental physiology as a science was only born about a hundred years ago. If we compare the progress made by medicine during the last hundred years with that of the previous thousand years, we shall be able to judge of the relative rates of progress of the two systems of working. The difference seems to me to lie in the fact that unaided clinical observation—that is, practically the empiric method—goes the wrong way about arriving at a conclusion. It says, Try this or that or the other remedy, and note which is successful. This is like a boy who will not systematically work out his sum in long division, but prefers to arrive at the quotient by guessing probable numbers one after the other, and multiplies them

to see which is the right one; he may, after much trouble, by chance hit upon the correct answer, but he more commonly fails: and most probably the boy who works out his sum in the straightforward way will far sooner arrive at the desired result. Physiology moves onward by means of accumulating and arranging facts which have borne the test of experiment. Empiricism accumulates observations which, without further test, are used to formulate theories that, as likely as not, are unfounded, and are as apt to mislead as to advance medical knowledge. When asked to give an example of the utility of experimental physiology in the treatment of disease, I feel inclined to answer with another question: Is there one reliable system of diagnosis or one mode of treatment now in use which has not been modified or improved, if not directly suggested, by physiological knowledge? And I must certainly confess that I know none. Before attempting to bring forward single cases, as instances where certain experiments have been of direct use to medical and surgical practice, I shall examine the question from the opposite stand-point, by taking some simple case of every-day occurrence, and glancing at its routine examination and treatment. We can then see to what extent vivisection influences the practitioner in the details of his daily work. We may safely take a case at random; one not associated very closely in our minds with any brilliant experimentation will, perhaps, be the best. The following case, which I happen to have seen recently, will do as well as any other:

Not long since I found a policeman examining a poor woman who was said to have had a "stroke." She lay speechless and motionless on a door-step; she showed no signs of convulsions, no stertorous breathing, no frothing at the mouth. So the policeman hesitated to make a diagnosis—thinking, no doubt, that other causes besides a "stroke" might give rise to such a want of muscular irritability. Gently shaking her had no effect, but on his applying some form of stimulus to the finger she showed signs of returning consciousness, and the *left* leg and arm moved slightly. The right eye remained partly open, the other was closed; when the eyelid was raised, so as to expose the pupil to the sunshine, some movement of the muscles of expression was observable, but only on the left half of the face, to which side the mouth was slightly drawn. This became more obvious when some drops of cold water were thrown at her. The pulsation of the temporal artery was visible. Putting my ear to the top of her chest I found the heart beating violently, and heard a prolonged blowing noise instead of the sharp, clear tone of the second heart-sound. Without much effort my thoughts had passed from the pulsating temporal artery to the heart, and from the imperfect aortic valves to the middle cerebral artery, where I fancied an embolus must be impacted. I told the policeman the woman had better be taken to a hospital, which was done accordingly.

How was it that I was able confidently to advise the policeman about this poor woman, though he was no doubt very experienced in this sort of cases? What aid did experimental inquiry give me in arriving at my conclusion?

Well, in the first place, I knew that the paralysis was restricted to voluntary movements, without the motions belonging to organic life being in the least interfered with. Vivisections of the earliest times informed me that this was quite possible as a result of some injury of the nerve-centers, and experiments of more recent date enabled me to exclude a large part of these centers from being the seat of the lesion. That there was no local injury of the spinal cord in the dorsal region I knew, both from the loss of consciousness and from the fact that the reflex action of the lower limbs was not intensified, and vivisections informed me they would have become so had this been the case. I could see by the movement of the left leg that only one side of the body was paralyzed; and then the look of the face distinctly showed that part of the seventh cranial nerve, which Charles Bell's vivisections taught me to know to be motor in function, was paralyzed. This fact, together with the ready reflex action of the eyes and the sound side of the face, which I knew by vivisection required unimpaired sensory nerves, showed me that it could not be a case of profound toxæmia such as the policeman supposed to be possible. I knew by vivisections performed by many English physicians and physiologists, some of whom are still among us, that the second heart-sound depended on a certain action of the aortic valves. Not hearing the familiar sound, I concluded that the aortic valves must be diseased. Experiments on living animals concerning coagulation of the blood within the vessels informed me that when the lining coat of a blood-vessel, or the heart, is diseased, little clots are often formed at the diseased or injured part. I knew, further, from Virchow's classical experiments on living animals, that emboli introduced into the arterial blood-current often become impacted in the middle cerebral artery, and that the embolic blocking of a brain-artery, by shutting off the blood from the area it supplied, caused a sudden arrest of function of the part. Although the nerves going to the various paralyzed muscles arose from very different regions of the cord and brain, I know by vivisections that there is a part of the cortex of the brain the injury of which would cause them all to be powerless. Clinical observation and pathological anatomy would have informed me that it was probably a brain-lesion; but, had it not been for the light thrown by vivisection on the few facts I was able thus hurriedly to observe, I should not have been much wiser than any other by-stander, and could only have agreed with them that it was a "stroke" of paralysis.

Now let us consider a surgical case. The other day I mentioned some of the old methods of operation, when buttons of vitriol, caustics, steel compresses, boiling oil, hot irons, a copious receptacle for

catching the blood, and elaborate machines, such as those on the table, were among the apparatus the surgeon had to prepare for operation.

Let us now turn to a modern operation, and let us consider whether our present *modus operandi* is influenced by the light which experimental inquiry has shed on physiology during the last century. I shall not attempt to recount any one of the numerous cases which the surgeon now approaches with perfect confidence of undoubted success, although a comparatively short time back they would have been looked upon as completely beyond his reach. Many such cases, which formerly would have led either to certain death, enduring misery, or life-long inconvenience, must occur to the minds of all here. Let us take a case of disease or injury requiring the amputation of a portion of an extremity. In the first place the patient is made quite insensible to pain by the administration of chloroform, or some such drug; not only is he insensible to pain, but also unconscious to all that he formerly would have been obliged to see and hear, by no means the least painful part of the operation. With regard to the use of anæsthetics, I shall not delay, for vivisection can not claim to be the sole means of introducing this great boon to modern surgery, although experiment on living animals played a most prominent part both in their discovery and their introduction into common use in this country, as has been frequently pointed out.

The next step in the operation is to make the part bloodless. This can be done in the following way: By holding up the limb for some time to facilitate the flow of blood from the veins, and thus to reduce the blood-pressure within these vessels, by which means the local vasomotor mechanisms are brought into play with considerable force, so as to reduce the quantity of blood in the limb, allowing only a limited flow to continue. Then Esmarch's elastic bandage may be applied to further empty the minute blood-vessels. By this means the textures to be cut into may be made to remain, during the active part of the operation, as bloodless as those of a corpse. The advantage of having no dread of hæmorrhage to induce haste, no blood to impede the view, or render the instruments difficult to handle, can hardly be overestimated. So that, even apart from the all-important point of preventing the weakly patient losing blood, this bloodless surgery must be regarded as one of the most important improvements in modern methods. And how far may it be traced to vivisection? We know that the contractility of the blood-vessels, and the high pressure of the blood in the arteries, as well as the motions of the heart and the course of the blood, were demonstrated by this means; and is not this the key of the whole matter? But, further, were we not familiar by vivisections, and by the removal of tissues from the bodies of recently killed animals, with the fact that the textures can retain their life and function for a considerable period after their normal circulation has

ceased, who would have dared to suggest that the entire limb of a living man should be deprived of its blood during the time occupied by a tedious operation?

Then, with regard to the means of permanently arresting the escape of blood from the wounded vessels. We have no longer a receptacle for blood; indeed, the handful of sawdust on the floor that was fashionable when I began medicine is no longer used. John Bell, after giving a graphic and fearful account of the terrors of hæmorrhage, says: "Is not this fear of hæmorrhagy always uppermost in the mind of the young surgeon? Were this one danger removed, would he not go forward in his profession almost without fear?" I do not think this fear ever crosses the mind of the young surgeon now, so rare are deaths from external hæmorrhage. I have never seen one death from such loss of blood in the twenty years that have passed since I first commenced to study medicine. Why has the dread of bleeding ceased to chill the heart of the surgeon when entering on an operation? Vivisection has not done all, but it has done much to help us to attain to this degree of excellence in our present methods.

The use of the ligature can be traced so far back in the history of medicine that it is impossible to say whether it was first used upon man or animals. Very definite accounts of it occur in the writings of the Arabians of the tenth or twelfth century. Although its value, or rather its great convenience, in military surgery was recognized and extolled by Ambroise Paré, the inestimable value of the ligature remained unknown in general practice for nearly a hundred years after his time. This was, no doubt, partly on account of the fact that experiment was not used to test its efficacy and mode of action until comparatively recently. By vivisections the chief errors in its application were by slow degrees removed, and now we rest almost exclusively on the improved method of tying arteries as the means of arresting the flow of blood from a recent wound. First of all, the nerves used to be included in the ligature. Vivisection showed the folly of thus attempting to confine the animal spirits, or nervous fluid, and practice proved that thus tying the nerves always caused excruciating agony, and often gave rise to fatal spasms (tetanus), which made ligature to be dreaded even by its warmest advocates. In the second place, the wide ligatures which were made of soft material and lightly tied over corks, etc., often failed to check the bleeding. Dr. John Thomson, of Edinburgh, was among the first who made experiments on this subject, and I believe much of the credit given to Jones really belongs to him. Following the precepts taught by Thomson, Jones also made numerous experiments on animals. He found that a hard, thin ligature, applied so as to cut the elastic inner coats and leave the tough outer wall of the vessel uninjured, was much more surely followed by a deposit of "coagulable lymph," and by more satisfactory occlusion of the vessel, than when one or several

soft bands were tied lightly on it. This fact hardly gained the universal and complete confidence of surgeons until further vivisections performed by Lister, Brücke, and others, showed that the smooth lining of the vessel was the chief factor in preventing coagulation, and that intravascular clots are formed most readily when the lining of the vessel was injured and the blood ceased to move. Instead of timidly tying a loose knot for fear of injuring the vessel, the surgeon now ties a firm ligature so as to rupture its lining coat, or at least to apply sufficient pressure to cut off its nutrition and thus cause its death in order to make a starting-point for the coagulation which must occur to secure its permanent closure.

Another great objection to the old ligatures was the delay they caused in coming away. This wearied the surgeon and exhausted the patient. The ligature was sometimes pulled away before its time, and this often gave rise to the much-dreaded secondary hæmorrhage. In counseling that the ligature be left alone, Petit adds the remark, as a kind of consolation, that he finds them generally to come away of themselves in about two or three months. Of this sort of annoyance we hear nothing now. Experiment on the lower animals has taught us the existence of the lymphatics and their absorbing power. Experiments upon living animals has shown us that this power of absorbing extends to such things as catgut, a material readily made into strong cords. Properly prepared catgut is, therefore, almost universally used as a ligature, the ends are cut off short, and the knot is left to be absorbed, and never once thought of again.

And, lastly, the edges of the wound are brought together with stitches of silver wire, silk, catgut, horse-hair, according to whether much or little traction or more or less coaptation is demanded. Undue tension, compression, gaping, and irregularity of the wounded part, are all avoided; a means of exit for serous oozing, etc., is provided by non-irritating drainage-tubes. The antiseptic dressings are applied carefully and exactly. Large tents, dossils of lint, rude compresses are not thought of. The aseptic wound heals without swelling or inflammation. No throb disturbs the patient's rest. No drop of pus comes from the cut surface. Fever, tetanus, pyæmia, second hæmorahage, as well as the old dread of the bleeding during the operation, are all nearly forgotten.

To the minds of the surgeons of the last century such a method of operation and such a mode of healing would probably suggest the longed-for magic remedies by means of which many hoped to replace the cauteries, caustics, compresses, and filthy dressings with which they strove to heal the open wounds of their exhausted and cachectic patients.—*Lancet.*

EVOLUTION OF THE CAMP-MEETING.

By JOSEPH PARRISH, M. D.

HALF a century ago, camp-meetings were chiefly the outgrowth of Methodist zeal and enthusiasm. They were a sort of religious holiday, when good men and women who were loyal to their convictions, and earnest to disseminate the truth as they understood and believed it, came from far and near, in sparsely settled regions of country, to kindle afresh in the hearts of each other the fervor and inspiration of their peculiar dogmas and methods.

Ox-teams and hay-wagons, the old-fashioned chaise and chair, the side-saddle and cart, were among the means employed to reach the place of meeting. Many also went on foot, making a long and weary pilgrimage. Congregations joined each other, employed their own means of transportation, carrying their own society tent and commissariat; and thus thousands came together with but one single object in view, which was, in the language of their distinguished founder, "to spread holiness throughout these lands." Their greatest preachers were called to join and help them; and, with characteristic fidelity, and sacrifice of personal ease, ecclesiastics of highest renown joined in the simplest and rudest methods of tent-life, and labored with power and efficiency to bring the thoughtless and wandering to a better and a higher life.

The preaching was simple, direct, and powerful, and the result was, large accessions to the church. A camp-meeting was a sort of religious harvest-home, an in-gathering of fruit from seed that had been sown during the year, in local churches, as well as from the direct influence of the special services. In addition to this, old fellowships were renewed and fraternal interests and greetings were revived, and, at its close, thousands of the faithful scattered to their homes again, with renewed assurances that camp-meeting work was a blessing to themselves and to others. Such was the old-time line of thought and expression. But now, times have changed. Population has increased rapidly, facilities for travel have multiplied, the desert and wilderness have been penetrated by railroads, and the adventurous frontiersman is not without numerous companionships.

Towns and churches have grown up, as the migrating crowds have moved on in one continuous caravan, until the mountains, and the Pacific slope beyond them, are already occupied; and we find prosperous settlements of miners, farmers, and adventurers of all kinds and grades, dwelling in the midst of each other. The fathers in the olden time would have looked to the West, with its moving multitudes, and planted their tents to capture them; but modern Methodism plants the churches as the people settle, and, to preserve the

camp-meeting feature of the denomination, they seek fields already populated and locate themselves in more profitable places. Where are these places? The answer to this question discloses a phenomenal fact, that, could it be announced to them, would bring the scarlet to the cheek of Wesley, and bow the heads of Asbury and Whitefield with confusion of face.

The camp-meeting of to-day is a very different affair. It is not an extemporaneous festival in which the membership of one or more churches take the lead, select a place of meeting, and invite neighboring churches to participate in a common service, each bearing its share of the burden, and then scatter to their homes, to disband and be as if they had not been. No, it is a very different thing. It is the fruit of a chartered association, with corporate rights and franchises, of the same nature as those which belong to banking and railroad associations. Of course, the corporators are religious men, and the controlling influence is secured to the ministry. A copy of such a charter is now before me. It gives the institution its corporate name, and states its object to be "the establishment and maintenance of a sea-side resort, founded upon Christian principles, and affording religious privileges as well as healthful recreation."

Provision is made for the transfer and redemption of stock, for voting by shares and by proxy, as is usual in other money-making companies. It defines the number of directors, one third of whom shall be ministers, and one other third shall be ministers and members of the Methodist Episcopal Church. Its president "*shall* be a regularly ordained minister of the Methodist Episcopal Church, having control of the conventions, assemblies, and other meetings that may, from time to time, be held on the premises; and the secretary and treasurer must give bonds for the faithful performance of their duty—in one instance, as high as thirty thousand dollars. Is not this an anomaly? The camp-meeting feature, if indeed it is prominent enough to be a feature, is merely incidental to the main object, viz., the establishment of a sea-side resort. To do this, land must be purchased, stock must be sold to pay for it, and the pastor-president is to be the executive officer through whom these conveyances are to be made, and by whom all the real-estate transactions are to be ratified. The entire time, out of the three hundred working days of the year, that is to be set aside for camp-meeting services, is ten days or a fortnight, and the remainder is occupied with the secular business of the concern. We are largely indebted to these associations for the grand development they have made, on the New Jersey coast especially. Witness Ocean Grove, Ocean City, and Atlantic Highlands. They have taken up coast-lands, some of which were comparatively worthless, and made them into fruitful towns, with prosperous and happy peoples. They are to be credited also with the testimony they have borne to sobriety and good morals, by preventing the sale of intoxicating liquors within their

boundaries; but it is a question for them to consider, whether the cause of Christianity has been actually benefited by their policy. It is a question whether the *sample* preaching of the present camp-meeting style is as effectual as were the direct and incisive appeals of those whose voices are now hushed in the grave. Is it not more after the manner of "trial-efforts"? Which can do the best? Who can make the best impression? It may be ornate, picturesque, and beautiful. It may captivate the senses and satisfy the taste of the hearers; but does it meet the needs of the multitudes who come to hear?

Again, are immense crowds of people wholesome? Are there always vigor and force and efficiency in numbers, unless there is exact unity?

In such promiscuous multitudes as crowd the cottages and the strand, and as go in and out of tents and barracks, coming as they do from all parts, and representing as they do various grades of social life, there must be forces and influences that are constantly at work, and whether their influence is toward the better or worse side of human nature it is hard to say. They are not all Christian professors, and they are all human. They are loosed from the restraints of home, and are on a vacation for pleasure. They are crowded together, and, in order to be physically healthy and morally pure, their environment must do much to assist them. In this regard their relation to space and surroundings should be, if possible, essentially promotive of such conditions. How is it? In the number of cottages and tents, especially those appropriated to cheap boarding, we venture to say that there are more people lodged and fed than can be found in any equal number of dwellings in any other city or community of an equal population of well-to-do people. This is of itself demoralizing. It is out of harmony with the spirit of the age, which demands freedom and space, in proportion to population, in a ratio that is overlooked or disregarded at such sea-side resorts. There is, however, one conservative and redeeming fact in connection with this practice of promiscuous crowding, and that is, that the season is short and the people live most of the time out-of-doors. The time is at hand, however, when there will be a change. It will not be tolerated by a sanitary-wise people that there shall continue an unwholesome contact of dwellings, with cess-pools and water-wells within stepping-distance of each other and from the kitchen-doors. Nor should buildings continue to be so contiguous that one may walk from roof to roof, under which people live in contracted apartments, separated by thin board partitions, which, even for purposes of common privacy and propriety, are scarcely sufficient. It is true, and justice demands its utterance, that later improvements have, to a good extent, avoided these evils, and that the class of private homes and boarding-houses now being built are more in accord with a civilization that, at a Christian resort especially, should be conspicuous.

The great end of these corporations is to establish and maintain sea-side resorts; that is to say, to sell and lease lots and to build houses. To provide a market and secure competition, conventions of various kinds meet at these ample grounds, occupy the commodious buildings, and transact their legitimate business. It is all done in the name of religion, and may or may not be in fact and in spirit harmonious with the most exalted standard of Christian methods, according to the outlook from which the subject is viewed. If we take Ocean Grove as the type of such places, it is not, after all, so great a marvel that it has grown from a desolate sand-bank to a beautiful city within the last twelve years, when we consider the whole case. With missionary conventions, Sunday-school anniversaries, temperance assemblies, and camp-meetings, drawing upon an immense constituency in all parts of the country, and bringing thousands of visitors to the spot, with fair opportunities for investing money with a good hope of speedy return, it is not surprising that investments were made. Then, every laudable thing was done to rekindle and keep alive denominational pride and loyalty. The lakes that bound the Grove on the north and south are named for Wesley and Fletcher, while the avenues and parks are known by the names of departed worthies, whose memory is revered by the Church; and then, to complete the programme of attractions, the annual camp-meeting, occurring in the height of the holiday season, is made the central, the pivotal figure around which all the others are grouped. It has been a success as a venture to establish a sea-side resort; whether it has been a success as a means of intensifying and purifying the religious life of the people is as yet a problem without a solution. The time is past when even the common mind measures the depth of human character, and gives it credit or not for truth and righteousness, by the amount of religious fervor or the degree of religious profession it may exhibit. To be acceptable to common sense, and appreciated by right-minded people, the manhood must show itself moved to all good activities by a force from within that is invincible—a force, in itself silent and unobserved, but in its effect on character demonstrative in a life of goodness.

SEWAGE AT THE SEA-SIDE.

By ALICE HYNEMAN RHINE.

AMONG the thousands who go to the sea-side for health and pleasure, few pay any attention to the hygienic conditions under which they are to live for three of the most trying months in the year. The furniture of parlors and size of dancing-rooms and amusement-halls are taken into consideration, instead of finding out how sewage

is disposed of and what relations cess-pool drains are having with the wells. Land-owners and hotel-keepers, following the drift of fashion, furnish what their patrons desire, neither side caring apparently how close a connection is established between animal excreta and the food which is eaten, the water which is drunk, and the air which is breathed.

Nor is this carelessness confined to places merely fashionable. In Ocean Grove, a religious resort, no attempt has yet been made to remove fecal accumulations by means of sewerage, or to substitute cleanly earth-closets for the disgusting cess-pool and privy. Hence the wells are polluted by human excreta, and the air smells vilely, particularly during the period of the great open-air camp-meetings.

At these gatherings over twenty thousand people assemble, who congregate together in a comparatively small space. The greater part of this multitude dwell in long lines of camp-tents, closely huddled together, and pay but little regard to hygienic methods. The executive committee of the association owning the place is equally neglectful, as they have made totally inadequate provision for carrying away the excreted material of so many people.

For the purpose of insuring better sanitary conditions than those prevailing elsewhere on the Jersey coast, Asbury Park was sewered, during the winter and spring of 1882, with eleven miles of clay pipes. Unfortunately for the traveling public, this sewerage system was a failure. Constructed in the slap-dash manner that prevails over the country generally, its working illustrated the fact that an imperfect sewer for sewage is worse than no sewer at all.

Why this system should not work well is easily understood by looking at the flat dead level of the Atlantic coast at this point, and learning that, to assist the discharge of sewage-matter into the ocean, the sewers have scarcely a fall of one inch in many hundred feet. Their outlets are built but little above low-water mark; consequently, when they get clogged by the tide, which they do except at low water, their gaseous contents are turned back over the land, to deal out disease and death in as many ways as Panurge had of making money.

Again, the principal outlet of the sewers empties immediately in front of and at the foot of the main street; effluvia from this, during the months of July and August, were emitted in morbific quantities; and, although natural causes prevented any outbreak of virulent types of disease, physicians were kept busy attending cases of fever, cramps, and dysentery. While it is admitted that this sewage-stench *per se* might not have been the cause of these disorders, yet there is strong probability of it, when it is considered that the sewage of Glasgow, although conveyed in barges over twenty-five miles, to a deep and wide loch out in the country, engendered new types of disease, and converted one of the healthiest sea-side resorts into a pestilential fever-center.

Some attempt at remedying this condition in Asbury was made by

erecting ventilators, consisting of vertical wooden pipes, about twelve feet in height. These chimneys, placed upon sites chosen apparently without any attention to vertical or horizontal curves in the system, gave forth such fearful smells that at times the beach in their vicinity was unendurable. One near the principal promenade was abolished upon the insistance of hotel proprietors.

This failure added one more to the list of futile experiments which have been made with tall chimneys, having for their purpose the creation of a strong draught from the sewer. Tried in England, they are said never to have worked satisfactorily.

The placing such ventilators, as well as sewers, in a sandy soil, is always a hazardous experiment. If the principal streets are unpaved, surface-sand is liable to fill the sewer and choke it. And paving will not prevent silting up where there is an insufficient fall to allow hydrostatic pressure to force out incoming waves and tides. When egress of sewer-contents is thus checked, "*cela va sans dire*," the air is filled with a most disgusting stench.

Unhealthy as this contaminated air is, sea-side visitors incur a more common danger in the pollution of water by sewage. This poisoning is done in many ways—by close proximity of wells to sewer-drains, and by flood-water from rain-storms, which, instead of being utilized, is allowed to flow off along the gutters, sidewalks, and roadways. Across level lands, down through porous sand, this water sinks unchecked into the soil, carrying with it all the filth washed from streets teeming with human life during the hottest months of the year.

Civilization's barbarism makes this the more dangerous through the custom of crowding pig-sties, cow and stable yards, cess-pools, and all dirt-receptacles close to springs, wells, and other sources of drinking-water.

Little or no attention is paid to this dirty practice, on account of the popular belief that filtration through the sand purifies water of the poisonous principles contained in sewage-matter. This idea has been disproved by experiments of the United States Geological Survey in 1881. Results were then ascertained which showed very clearly that sand interposes absolutely no barrier between wells and the bacterial infection from cess-pools and privies lying even at great distances in the lower wet stratum of sand. Professor R. Pumpelly, who conducted the survey, says that filtration of sewage-water, through a great many feet even of sand as well as gravel, fails to free it of its organic impurities and the germs of disease.

In consequence of general ignorance of this fact, even when water is sufficiently impregnated with impurities to have acquired a foul taste, the mass of people will drink it without observation; or only notice it so far as to remark that "good water is never found at the sea-side." The majority drank without hesitation at Long Branch, or simply adulterated the water with wine or brandy, even after inves-

tigation had shown that the feeding-springs from which the water supply was drawn were contaminated by soakage from hog-pens and other animal refuse which had been allowed to percolate the soil unchecked.

The careless drinking of water so poisoned was the cause of an outbreak of typhoid fever during the past season at Seabright, a village adjacent to Long Branch, and supplied with water from the same source. Red Bank and Atlantic City were simultaneously afflicted with zymotic and malarial fevers through a similar cause; while Newport, heretofore considered a healthy sea-side resort, had a case of Asiatic cholera, and diarrhœa was almost epidemic. These conditions resulted from imperfect sewer-traps, by which almost every well and cellar in Newport was contaminated, unclean streets, filthy with the dirt of numerous horses, and sewers in a state the worst that could possibly be imagined.

From such causes as these an unusual amount of sickness prevailed during the past season along the whole line of the Atlantic sea-coast.

In these sporadic cases Nature sounded that key-note of warning with which she always precedes an epidemic. If unheeded, another season may witness the usual calamitous results that have invariably occurred before man has been taught that saddest and most difficult of hygienic lessons—how to protect life from filth-diseases.

This problem has been solved in great measure for the hamlet by almost all large cities. Wherever men have congregated in great numbers, plagues have occurred until they have learned to be careful of the disposition of their sewage. Memphis, which is one of the latest instances, after being terribly scourged by yellow fever in 1878, and again in 1879, took the precaution to immediately institute sanitary reforms, which have been followed by the best practical results. The leading features in these improvements were: the cleansing of the city of all objectionable accumulations, the abolition of all privy-vaults, cess-pools, and improperly constructed underground and surface drains, and the substitution of a complete system of sewers and subsoil drainage-pipes. The water-supply was improved, and the streets properly paved.

What has been accomplished by these measures for the proper sanitation of Memphis and other business centers is what remains to be done for the health and comfort of sea-side towns and villages along the Atlantic coast.

ICEBERGS AND FOG IN THE NORTH ATLANTIC.

By Captain J. W. SHACKFORD.

DURING the season of 1882 the ice and fog in the track of steamers running between Europe and North America appear to have attracted much more attention than heretofore, not only in consequence of the unusual quantities of field-ice and bergs reported, but also be-

cause of the increase in the traffic, and in the number of passengers transported.

Every one who has sailed for any number of passages on the western route *via* 43° latitude and 50° longitude—the track usually followed in ice-months—must have often experienced the sudden change from a dense fog to fine, clear weather, and sometimes to an almost cloudless sky. This change occurs most frequently to the westward of the Grand Bank, and with the wind to the south of west; the clearing which follows a northerly wind taking place more slowly. This sudden lifting of the fog is nearly always due to a change in the temperature of the surface-water. In sailing from the 43d to the 41st parallel, between the Grand Bank and George's, I have occasionally known the fog to clear and shut down again many times during the twenty-four hours; and almost invariably, upon trying the surface-water, found that while the weather continued clear the surface-temperature rose to between 55° and 65° Fahr., and, upon the temperature of the water falling below 55° Fahr., the fog again closed in; to be again followed by clearer weather as the ship sailed into warmer water—thus alternating from a dense fog to a clear sky and pleasant weather for hundreds of miles.

In the summer of 1875, during which great quantities of ice were encountered, I began to experiment on running south to clear the fog. Probably the idea originated from my knowledge of the courses taken by the old New York and Liverpool packets, nearly all of which, on leaving Sandy Hook, in the spring and summer months, steered east by south true until they were to the eastward of 70° longitude, and crossed the 50th meridian very rarely to the northward of 43° latitude, and generally in 42° or south of that parallel. In the course of one or two seasons, on comparing our logs of previous years and those of other steamers leaving about the same dates, with our logs on the southerly route, the conviction became irresistible that crossing 50° west to the southward of 41° latitude was the safest course eastward bound. I am fully aware of the many arguments that may be used against this southern route for both east and west bound steamers; among others, the Gulf Stream, the longer distance, the discomfort to passengers in a crowded ship, the excessive heat in the fire-room, and probably many others; but, after much attention to the subject, I am convinced that these objections are more than counterbalanced by almost certain immunity from fog and ice, or the assurance that, if the latter is encountered, it will be in clear weather. I have therefore continued crossing the meridians of 50° and 45° farther to the southward every year during the ice-months, until in the present year (1882), after having made ten passages east and west, from March to August inclusive, only one hour and thirty-one minutes of fog has been encountered between Cape Henlopen and Cape Clear on the eastern passages, and that was experienced in 65° west in the month

of March; and, on the western passages, nine hours and forty-three minutes in May, to the westward of 70° longitude, and six hours and thirty-six minutes in August, between the 23d and 33d meridians; while not a particle of ice has been seen during the entire season. Bergs have no doubt been reported to the southward of these tracks this year, but very rarely, and so few of them reach this latitude that the chances of seeing any are very small.

What this immunity from fog and ice means may be appreciated by any one, landsman or sailor, who will take the trouble to look over the files of the "New York Herald" for the "reports" of arrivals of steamers, or those of the New York "Maritime Register," where their logs are published. Here are a few, selected at random:

"Steamer 'Emberiza' (Br.), Dundee, February 12th, *via* Halifax: February 25th, 8 P. M., while running before a strong easterly wind with a heavy sea, got into immense quantities of field-ice; hauled ship to southeast and east to clear it; steamed slow all night, and received some damage to bows while clearing the ice, ship making a little water in fore compartment; 28th, 8 A. M., after three days' slow steaming, during which time the ship was at times completely blocked, passed a small iceberg and the last of the ice."—*New York Herald, March 7th.*

"Steamer 'Nevada' (Br.), Liverpool: April 12th, passed several large icebergs, and great quantities of field-ice."—*Ibid., April 24th.*

"Halifax, April 26th: The steamer 'Mark Lane' left Dundee, . . . thirty-six days ago. Three weeks ago the ice was sighted and every effort was made to keep away from it, but without success, and the steamer was soon in the midst of a vast field, with a very slight prospect of an early escape. From then until last Monday, although clear water would sometimes be reached for a short time, ice was never lost sight of. . . . Shortly after getting into the ice the coal on board gave out. . . . All the wood available was then obtained and burned, and at last the shipping (shifting?) boards had to be cut away, and even the top-mast broken up for fire-wood."—*Ibid., about April 27th.*

"Steamer 'Daniel Stienmann' (Belg.), Antwerp, April 12th: Had strong southwest winds to longitude 40°; thence variable winds, foggy and misty weather. April 25th, passed a large iceberg; 28th, saw a large iceberg, and subsequently passed fifteen others, also an ice-field ten miles long; steered one hundred miles southwest by west one half west (south 37° west true?), when the last iceberg was passed."—*Ibid., May 2d.*

"Boston, May 1st: The British steamer 'Glamorgan,' of the Warren line, arrived here this morning from Liverpool. . . . About four o'clock on the morning of the 26th (April), while going eleven knots an hour, she ran into a field of pack-ice and icebergs; . . . a run of twenty miles was made to the southeast, when the ship was put on her course again. She steamed one hundred and sixty miles on the southern edge of the field-ice, and during that time passed fully one hundred large icebergs. . . . The course of the vessel was changed, as the presence of the ice made it necessary, and a long passage was the result."—*Ibid., May 2d.*

"Steamer 'Jason' (Dutch), Amsterdam, April 20th: May 1st, fell in with ice, and remained in it three days; passed numerous very large icebergs; had a hole stove in fore-peak."—*Ibid., May 12th.*

"Steamer 'India' (Ger.): May 24th, passed two icebergs during a dense fog. Slowed engines until next morning, when fog lifted and found vessel surrounded by icebergs; counted thirty-five of them. The fog shut down again, and was obliged to stop vessel several times. At 10 A. M. struck an iceberg and stove two holes in starboard bow. The last ice was seen in latitude 42° 35′, longitude 52°, when three bergs were passed."—*Ibid., May 31st.*

"Steamer 'America' (Ger.), . . . was detained on the Banks and vicinity many hours by fog. June 10th, latitude 42° 30′, longitude 50° 36′, passed through a regular fleet of icebergs, one of them at least three hundred feet high; . . . weather thick and foggy, and was obliged to proceed slowly."—*Ibid., June 14th.*

"Steamer 'State of Nebraska' (Br.) was detained thirty hours on the Banks by dense fog."

"Steamer 'Devonia' (Br.) was detained eighteen hours by dense fog."—*Ibid., July 19th.*

"Steamer 'Polaria' (Ger.) had strong westerly gales and high head-seas with dense fog nearly all the passage."—*Ibid., July 20th.*

"Steamer 'Devon' (Br.) sighted a large iceberg on the eastern edge of the banks; thence light winds and fog."—*Ibid., July 23d.*

"'Abyssinia' left Liverpool June 3d: June 11th, light wind and dense fog, passed several icebergs, engines slowed and stopped; 12th, light winds and dense fog, passed several icebergs; 13th, light southeast winds and fog, passed several icebergs, engines slowed."—*New York Maritime Register, June 21st.*

The above are only a few of the many instances of steamers encountering fog and ice during the last season, and sustaining more or less damage. It is difficult which to most admire, the skill and seamanship exercised in extricating some of these vessels from difficult and dangerous situations, or the pertinacity with which they continued, month after month, to follow the same track in the face of the reports published day after day in the "Herald" and "Maritime Register," with hardly any intermission, from March to August. It may be replied that the last spring and summer have been exceptional ones for ice, which is doubtless true; but, since 1875, including that year eight seasons, we have had, for the first year, ice down very early; field-ice and bergs were seen in February, and continued into September and October. For 1876, bergs and field-ice seen in the early part of the year, February; and in August, September, and October an immense number of bergs on the Banks and to the northward of them. During the three following years, very few seen; only occasional bergs, including the one seen by the Arizona in November, 1879. In the season of 1880 there was a constant stream of icebergs along the eastern edge of the Grand Bank from March until July, some of them having been seen as far south as 40° latitude. In 1881, occasional bergs; and the ice and fog of the last season are too recent to have been as yet forgotten. Here we have, out of eight seasons, four in which ice was almost certain to be encountered from two to six months in each spring and summer. In those seasons during which very little ice

was reported, how was it to be known at what moment it might not have been fallen in with? As we have seen above, in some years the ice comes down in February; perhaps the next year not until September. Can any one doubt that, the longer we continue to run without seeing ice, the more emboldened we become to continue running through the region where it is liable to be met with, in all kinds of weather, trusting partly to our escape from accident in the past for security in the future? If this is not so, the nature of shipmasters must be different from ordinary human nature; and that the observation is a true one is, I think, proved by the experience of the past season, when so many steamers continued to round the south end of the Grand Bank, voyage after voyage, in a latitude where ice was almost as certain to be encountered as the sun was sure to rise in the morning; and when it was also as certain that, by crossing the meridian of 50° a hundred miles farther to the southward, the ice could have been avoided altogether.

The facts appended are the result of careful observations, taken from June, 1875, to August of last year. The instruments were compared frequently with standards, the temperature of the water taken at least every hour, and, when changes were anticipated, sometimes every ten minutes, between Henlopen and Cape Clear, and the hours and minutes of fog noted when the whistle was blowing or when we could not see far enough to clear a vessel without difficulty. I presume it will be conceded that many more hours of hazy or misty weather would be encountered on the northern than on the southern route; the vicinity of the colder water naturally bringing with it more hours when a vigilant lookout would have to be kept, but when it would not be necessary for the steam-whistle to be sounded. The observations comprise thirty-two eastern and twenty-seven western passages, from March to August inclusive, on routes one to five, and five western passages in August, *via* Cape Race, on the middle of the Bank. The eastern passages, from 1875 to 1879, were sailed on track No. 3, which crosses the 50th meridian in about 41° latitude, and hauls sharp to the northward, on the Great Circle for the Fastnet. For 1880–'81 track No. 4 was followed, with the exception of the March passage in 1881, when 50° longitude was crossed in 42° latitude, thereby reducing slightly the average distance for the season. During the season of 1882, track No. 5 was taken from April to August.

On the western passages, track No. 1, the route generally taken in these months, was followed as closely as possible from 1875 up to and including the June trip of 1880. The July passage of that year was made on track No. 4. For the year 1881 the earliest trip, April, was made on track No. 1; the subsequent passages on No. 4. During the present year, with the exception of the March trip, the passages have been made entirely on the extreme southern track, No. 5.

In following track No. 4, on eastern passages 56 and 63, six hours and forty minutes of fog was encountered between 40° and 60° longitude, and on the western passages 56, 63, and 64, nine hours and fifty-one minutes between the same meridians. This fog, on these five passages, was found always very near the 48th meridian; the mean temperature of the surface-water, while the weather continued foggy, being 53° Fahr. in the early part of July, and 65° in the latter part of the same month; falling in a few moments from, and rising as rapidly to, 89° in the former and 78° in the latter instance. This belt of cold water, and of fog, which was entirely avoided on route No. 5 in 1882, is described in Maury's "Physical Geography of the Sea." In writing of the Gulf Stream and climates of the ocean, he says: "Navigators have often been struck with the great and sudden changes in temperature of the waters hereabout; . . . this 'bend' is the great receptacle of the icebergs which drift down from the north; covering frequently an area of hundreds of miles in extent, its waters differ as much as 20°, 25°, and in rare cases as much as 30° in temperature from those about it. Its shape and place are variable. Sometimes it is like a peninsula, or tongue of cold water, projected far down into the waters of the Gulf Stream." In May, 1881, on track No. 4, the width of this "tongue" was about fifty miles, and on the following passage in June less than thirty miles. On the latter passage I was enabled to predict its position with such certainty that I struck it inside of half an hour of the time expected. All the fog experienced on track No. 4 between the 40th and 60th meridians has been met with in this immediate vicinity. With the limited number of observations, taken only on one ship, it would no doubt be premature to give an opinion as to the fixed locality of this tongue of the Arctic current; but I can nevertheless confidently affirm that between 40° and 60° longitude, the tables below, with the observations of the temperature of the surface-water, show, beyond dispute, that by an additional hundred miles of distance, the chances of meeting fog in the spring and summer months are almost, if not entirely, avoided. Whether it is worth the loss, from the additional distance, to escape fog and very nearly all the ice, is a question for each to decide for himself.

The following table shows the hours of fog and distance sailed on the voyages described above:

Track No. 1.—43° latitude, 50° longitude, to Fastnet on the Great Circle.

No. 2.—42° latitude, 50° longitude, to Fastnet on the Great Circle.

No. 3.—41° latitude, 50° longitude, to Fastnet on the Great Circle.

No. 4.—41° latitude, 50° longitude, to 42° latitude, 45° longitude, thence to Fastnet on Great Circle.

No. 5, East.—40° 30″ latitude, 50° longitude, to 41° latitude, 47° longitude, thence to Fastnet on Great Circle.

No. 5, West.—Fastnet to 41° latitude, 47° longitude, thence to 40° latitude, 50° longitude, thence to Cape Henlopen.

EASTERN PASSAGES.

VOYAGE.	Month.	Hours of Fog. Total.	Between 40° and 60° W.	Distance sailed.
		Hours. Min.	Hours. Min.	Miles.
		1875.		
13	June	0 0	0 0	2,995
14	July and August	0 0	0 0	2,979
2 passages		0 0	0 0	5,974
Average		0 0	0 0	2,987
		1876.		
20	March and April	0 0	0 0	2,995
21	May	0 0	0 0	2,988
22	June	23 15	20 45	2,978
23	July and August	8 0	8 0	2,955
4 passages		31 15	28 45	11,916
Average		7 49	7 11	2,979
		1877.		
29	April	0 0	0 0	2,982
30	June	8 0	0 0	2,975
31	August	0 0	0 0	2,944
3 passages		8 0	0 0	8,901
Average		2 40	0 0	2,967
		1878.		
36	March	0 0	0 0	2,987
37	April and May	10 45	0 0	2,990
38	June	17 45	17 45	2,989
39	July	13 39	0 0	2,950
4 passages		42 9	17 45	11,916
Average		10 32	4 26	2,979
		1879.		
45	April	0 0	0 0	2,962
46	May	5 52	3 50	2,988
47	June	4 15	4 15	2,974
48	July	8 43	0 0	2,988
4 passages		8 50	8 5	11,892
Average		4 42	2 1	2,973
		1880.		
53	March	0 0	0 0	2,995
54	April	0 0	0 0	2,997
55	May	0 0	0 0	2,999
56	June and July	7 0	3 0	3,005
57	August	0 0	0 0	2,991
5 passages		15 0	3 0	14,987
Average		3 0	0 36	2,997
		1881.		
62	March	2 35	2 35	2,959
63	April and May	3 40	3 40	2,984
64	May and June	8 58	0 0	3,025
65	July	2 54	0 0	3,013
66	August	0 0	0 0	2,971
5 passages		18 7	6 15	14,957
Average		3 37	1 15	2,991

EASTERN PASSAGES—(*continued*).

VOYAGE.	Month.	Hours of Fog.		Distance sailed.
		Total.	Between 40° and 60° W.	
		Hours. Min.	Hours. Min.	Miles.
		1882.		
71	March	1 31*	0 0	3,005
72	April	0 0	0 0	3,016
73	May	0 0	0 0	3,026
74	June and July	0 0	0 0	3,025
75	July and August	0 0	0 0	3,025
5 passages		1 31	0 0	15,097
Average		0 18	0 0	3,019

WESTERN PASSAGES.

VOYAGE.	Month.	Hours of Fog.		Distance sailed.
		Total.	Between 40° and 60° W.	
		Hours. Min.	Hours. Min.	Miles.
		1875.		
13	July	18 5	0 0	2,945
1 passage		18 5	0 0	2,945
		1876.		
20	April	15 15	9 35	2,950
21	May and June	44 55	16 45	2,935
22	July	53 33	5 20	2,902
3 passages		113 43	31 40	8,787
Average		37 54	10 33	2,929
		1877.		
28	March	16 0	0 0	2,913
29	May	4 0	4 0	2,915
30	July	39 0	26 0	2,908
3 passages		59 0	30 0	8,736
Average		19 40	10 0	2,912
		1878.		
36	March and April	23 30	17 0	2,920
37	May	36 13	24 28	2,925
38	June and July	10 19	0 0	2,918
3 passages		70 2	41 28	8,763
Average		23 21	13 49	2,921

All these passages on track No. 1, *via* 43° latitude, 50° longitude.

* In longitude 65° west, between tracks No. 2 and No. 3.

WESTERN PASSAGES.

VOYAGE.	Month.	Hours of Fog. Total.	Between 40° and 60° W.	Distance sailed.
		Hours. Min.	Hours. Min.	Miles.
		1879.		
44	March	5 16	0 0	2,917
45	April	4 35	0 0	2,913
46	May and June	17 30	12 0	2,919
47	July	10 50	0 30	2,912
4 passages		38 11	12 30	11,661
Average		9 33	3 7	2,915
		1880.		
53	March	2 30	2 30	2,912
54	May	22 25	11 15	2,915
55	June	0 0	0 0	2,917
56	July	8 0	8 0	3,019
4 passages		32 55	21 45	11,763
Average		8 14	5 26	2,941
		1881.		
62	April	12 20	12 20	2,907
63	May	3 5	1 15	3,023
64	June	3 41	0 36	3,020
65	July and August	0 50	0 0	3,011
4 passages		19 56	14 11	11,961
Average		4 59	3 33	2,990
		1882.		
71	March and April	0 0	0 0	3,016
72	May	9 43*	0 0	3,024
73	June	0 0	0 0	3,026
74	July	0 0	0 0	3,026
75	August	6 36†	0 0	3,026
5 passages		16 19	0 0	15,118
Average		3 16	0 0	3,024

CAPE RACE PASSAGES.

VOYAGE.	Year.	Month.	Hours of Fog. Total.	Between 40° and 60° W.	Distance sailed.
			Hours. Min.	Hours. Min.	Miles.
14	1875	August	26 5	10 50	2,861
23	1876	August	5 30	5 30	2,862
31	1877	August	5 30	2 30	2,853
39	1878	August	23 51	1 15	2,857
48	1879	August	0 30	0 0	2,856
5 passages			61 26	20 5	14,289
Average			12 17	4 1	2,858

The comparisons for the different years, omitting the Cape Race passages, are as follows:

* West of 70° longitude.

† Between 23° and 33° west.

EASTERN PASSAGES.

YEAR.	Number of passages.	Hours of Fog.				Average distance sailed, per passage.
		Total.	Average, per passage.	40° to 60° W.	Average, per passage.	
		Hours. Min.	Hours. Min.	Hours. Min.	Hours. Min.	Miles.
1875.....	2	0 0	0 0	0 0	0 0	2,987
1876.....	4	31 15	7 49	28 45	7 11	2,979
1877.....	3	8 0	2 40	0 0	0 0	2,967
1878.....	4	42 9	10 32	17 45	4 26	2,979
1879.....	4	18 50	4 42	8 5	2 1	2,973
1880.....	5	15 0	3 0	3 0	0 36	2,997
1881.....	5	18 7	3 37	6 15	1 15	2,991
1882.....	5	1 31	0 18	0 0	0 0	3,019

WESTERN PASSAGES.

YEAR.	Number of passages.	Hours of Fog.				Average distance sailed, per passage.
		Total.	Average, per passage.	40° to 60° W.	Average, per passage.	
		Hours. Min.	Hours. Min.	Hours. Min.	Hours. Min.	Miles.
1875.....	1	18 5	18 5	0 0	0 0	2,945
1876.....	3	113 43	37 54	31 40	10 33	2,929
1877.....	3	59 0	19 40	30 0	10 0	2,912
1878.....	3	70 2	23 21	41 28	13 49	2,921
1879.....	4	38 11	9 33	12 30	3 7	2,915
1880*.....	4	32 55	8 14	21 45	5 26	2,941
1881†.....	4	19 56	4 59	14 11	3 33	2,990
1882‡.....	5	16 19	3 16	0 0	0 0	3,024

By the above tables the average hours of fog for each passage show a decrease in the eastern passages from seven hours forty-nine minutes in 1876 and ten hours thirty-two minutes in 1878, to three hours, and three hours and thirty-seven minutes in 1880 and 1881, and eighteen minutes in 1882; and between the sixtieth and fortieth meridians, the ice-region, from an average of seven hours eleven minutes in 1876 to one hour fifteen minutes in 1881, and an entire immunity from fog in 1882; for the western passages a decrease from an average of thirty-seven hours fifty-four minutes of each passage in 1876 to four hours fifty-nine minutes in 1881, and three hours sixteen minutes in 1882; while in crossing the ice-region the average is reduced from ten hours thirty-three minutes in 1876 to three hours thirty-three minutes in 1881, and an entire absence of fog in 1882.

Comparing the western passages *via* 43° latitude, 50° longitude (route No. 1), with the extreme southern passages (routes 4 and 5), the result is as follows:

* One passage, southern route (track No. 4).

† Two passages, southern route (track No. 4).

‡ One passage, southern route (track No. 4). Four passages, southern route (track No. 5).

WESTERN PASSAGES,

via 43° latitude, 50° longitude. (*Route No. 1.*)

VOYAGE.	Month.	Hours of Fog.				Distance sailed.
		Total.		40° to 60° W.		
		Hours.	Min.	Hours.	Min.	Miles.
13	July	18	5	0	0	2,945
20	April	15	15	9	35	2,950
21	May and June	44	55	16	45	2,935
22	July	53	33	5	20	2,902
28	March	16	0	0	0	2,913
29	May	4	0	4	0	2,915
30	July	39	0	26	0	2,908
36	March and April	23	30	17	0	2,920
37	May	36	13	24	28	2,925
38	June and July	10	19	0	0	2,918
44	March	5	16	0	0	2,917
45	April	4	35	0	0	2,913
46	May and June	17	30	12	0	2,919
47	July	10	10	0	30	2,912
53	March	2	30	2	30	2,912
54	May	22	25	11	15	2,915
55	June	0	0	0	0	2,917
62	April	12	20	12	20	2,907
18 passages		336	16	141	43	52,543
Average		18	41	7	52	2,919

WESTERN PASSAGES,

via Southern Route. (*Nos. 4 and 5.*)

VOYAGE.	Month.	Hours of Fog.				Distance sailed.
		Total.		40° to 60° W.		
		Hours.	Min.	Hours.	Min.	Miles.
56	July	8	0	8	0	3,019
63	May	3	5	1	15	3,023
64	June	3	41	0	36	3,020
65	July and August	0	50	0	0	3,011
71	March and April	0	0	0	0	3,016
72	May	*9	43	0	0	3,024
73	June	0	0	0	0	3,026
74	July	0	0	0	0	3,026
75	August	†6	36	0	0	3,026
9 passages		31	55	9	51	27,191
Average		3	33	1	6	3,021

and the comparative loss of distance as under

	Miles.
Average distance lost each western passage	102
Average distance lost in nine passages	918

To compensate for which loss of distance, we have—

	H.	M.
Average of fog per passage on the northern route (track No 1)	18	41

* West of longitude 70°. † Between 23° and 33° west.

reduced to—

Average of fog each passage on the southern route.....	3 33

and—

Average of fog each passage through the ice-region by former route.....	7 52

reduced to—

Average of fog each passage through the same by latter route..	1 6

and, omitting the fifty-eighth voyage, have actually an average of only fourteen minutes of each passage for eight passages through the whole region of the Atlantic where ice is liable to be encountered. Another fact that should not be forgotten in the comparison is the maximum amount of fog liable to be met with (see twenty-second and thirtieth passages west) on the northern route (track No. 1).

CAPE RACE IN AUGUST.—On this route for this month we have—

	MILES.
Average distance sailed each passage.....	2,858
Average distance sailed each passage by extreme southern route.	3,021
Loss of distance each passage	163

Against which loss of distance, we find the average of fog as above, instead of—

	H.	M.
Average hours of fog, Cape Race.....	12	17
Average hours of fog through the ice-region.....	4	1

and—

Maximum amount of fog on thirty-ninth voyage	23	51

As I have seen ice on three out of five of these August passages *via* Cape Race, it is an open question which is the best route for this month in ordinary years. Where the ice has continued so late as in the present season, I should certainly prefer the southern route. Below is the report of the steamer Main (Ger.), *via* Cape Race, in July of the present year, arriving in New York on the 20th of that month: "Passed Cape Race July 18th; . . . from Sable Island to Sandy Hook had continuous fog; July 19th (?) latitude 47° 45′, longitude 48° 12′, passed an iceberg; same date, latitude 46° 56′, longitude 52° 24′, up to Cape Race, for a distance of thirty miles numerous large and small icebergs; same date, latitude 46° 11′, longitude, 53° 54′, two large icebergs."

CURRENTS.—I was much surprised, on comparing the total distances, by observation and account, for these westerly passages, to find that the average current was less on the southern than on the northern route.

The following shows the comparison for the twenty-seven westerly passages:

CURRENT ON WESTERN PASSAGES,

via latitude 43°, longitude 59°. (*Track No. 1.*)

VOYAGE.	Month.	DISTANCE.		CURRENT.	
		Observed.	Account.	East.	West.
		Miles.	Miles.		
13	July	2,945	3,071	126	..
20	April	2,950	2,942	..	8
21	May and June	2,935	3,010	75	..
22	July	2,902	2,948	46	..
28	March	2,913	2,901	..	12
29	May	2,915	2,867	..	48
30	July	2,908	2,948	40	..
36	March and April	2,920	2,920	..	..
37	May	2,925	2,848	..	77
38	June and July	2,918	2,935	17	..
44	March	2 917	2,939	22	..
45	April	2,913	2,925	12	..
46	May and June	2,919	2,909	..	10
47	July	2,912	2,967	55	..
53	March	2,912	2,879	..	33
54	May	2,915	2,904	..	11
55	June	2,917	3,015	98	..
62	April	2,907	2,977	70	..
18 passages		52,543	52,905	561	199
Difference			362	easterly	
Average per passage			20		

CURRENT ON WESTERN PASSAGES,

via Southern Route. (*Tracks Nos. 4 and 5.*)

VOYAGE.	Month.	DISTANCE.		CURRENT.	
		Observed.	Account.	East.	West.
		Miles.	Miles.		
56	July	3,019	3,015	..	4
63	May	3,023	2,973	..	50
64	June	3,020	3,068	48	..
65	July and August	3,011	3,046	35	..
71	March and April	3,016	3,028	12	..
72	May	3,024	3,009	..	15
73	June	3,026	3,056	30	..
74	July	3,026	3,056	30	..
75	August	3,026	3,027	1	..
9 passages		27,191	27,278	156	69
Difference			87	easterly.	
Average for passage			10		

As long as our navigation laws of the last century continue unrepealed, probably the facts contained in the above tables will be of little interest to steamship-owners in the United States; but underwriters and shippers are certainly concerned, as to the proportion of steamers in the North Atlantic trade that escape from or meet with detention,

accident, or loss. The immense proportions that the traffic between Europe and the United States is bound to assume within the next fifty years appear to make it almost a necessity that the ocean between the two countries should be as well known as the country between New York and San Francisco, or between Liverpool and London. That this subject has been almost a matter of indifference to the governments interested, until very recently, can not be better illustrated than by the fact, almost incredible, but nevertheless true, that a shoal on the eastern edge of the Grand Bank, directly in the track of steamers running between the two countries for the greater portion of the year, marked "Ryder Rock, twenty-one feet, position doubtful," was laid down on the charts published by the British Admiralty and United States Hydrographic Offices, until 1879, in which year the bank was resurveyed, and the shoal found to have had no existence. The United States and British Governments have recently spent thousands of dollars in Arctic explorations and relief expeditions, one of the results of which has been to show how gallantly death can be encountered. Surely, a few thousands would be well expended in the survey of this ocean highway on which thousands of lives are constantly afloat; and certainly government ships might be worse employed than in an attempt to give greater security to life and property on its treacherous surface.

If the publication of these two articles* should be the means of causing one ship-master to try the southern route, or deter one steamer from ramming into an ice-field on the eastern edge of the Grand Bank, in the spring of the year, the writer will be amply repaid for any time and trouble they may have cost him.

REMEDIAL VALUE OF THE CLIMATE OF FLORIDA.

By GEORGE E. WALTON, M. D.,
MEMBRE DE LA SOCIÉTÉ FRANÇAISE D'HYGIÈNE, PARIS, ETC.

"Know ye the land of the cedar and vine,
Where the flowers ever blossom, the beams ever shine,
. . . . . .
Where the citron and olive are fairest of fruit,
And the voice of the nightingale never is mute?"

WHEN one approaches this land, from the northward, in the winter season, having left the hills and valleys about his home covered with the cold, white mantle of winter, he is pleased and cheered by the green foliage. The breezes which touch him possess a delicious softness and a fragrant, spicy aroma. When, at the shores of the St. John's River, he looks over miles of clear and unruffled

* See the first article, in "Harper's Magazine" for August, 1882.

water, many miles in width, like an inland lake, and reaching far away, hundreds of miles to the south, fringed by green inlet and headland, bearing the tropical foliage of cypress and orange, palmetto and palm; when the mild sunshine, falling so softly upon forest, bank, and river, has penetrated him till he feels a gentle warmth flowing through his veins; when a delicious languor has possessed him, and it would seem perfect happiness to rest in the genial sunshine forever—then he knows he has found the sweet do-nothing land of America.

Warmth is life, cold is death, and the medical study of climate is only an analysis of those conditions of heat which will best secure an abounding vitality in the healthy human organism, or restore a shattered organism to its normal physical relations.

Men, like children, continually cry for the unattainable. We would like a land in which a perfect June always prevails.

What are the factors in the climate of Florida? Heat, water, and light—warmth, moisture, and sunshine.

The health resort of Florida is the peninsular portion, averaging one hundred miles in width and projecting southward over three hundred miles, amid the waters of the Atlantic Ocean and Gulf of Mexico.

It is a flat land, composed almost entirely of sand. So much does it resemble a jetty of sand, such as we see formed at the confluence of streams, that it may appropriately be termed an ocean sand-bar, with everglades, marshes, and lagoons in the southern portion, testifying how recently, geologically speaking, it has emerged from the depths of the sea. Around this sickle-shaped peninsula the Gulf Stream, with an average temperature of 86° Fahr., sweeps from the southernmost point along the eastern shore at a distance of ten to one hundred miles from the coast. Across it the salt-laden breezes of the ocean continually play, by day and by night. Upon it the warm rays of a semi-tropical sun almost continually shine.

What are the results of these physical conditions, stated in the exact terms of meteorological science? For this purpose it is not necessary to array long tables of average temperature, mean monthly range, rain-fall, barometric pressure, relative humidity, etc.

It is sufficient to know that the average temperature of Jacksonville, for the month of November, is 61° Fahr.; December, 54° Fahr.; January, 55° Fahr.; February, 57° Fahr.; March, 62° Fahr. The rain-fall in November is 3½ inches; December, 3 inches; January, 3 inches; February, 2½ inches; March, 4½ inches. St. Augustine, Palatka, and Gainesville average 2° or 3° warmer than Jacksonville. At St. Augustine the rain-fall is less than at Jacksonville, being, November, 1·2 inch; December, 2 inches; January, 2 inches; February, 1·6 inch; March, 2·3 inches. The mean monthly range of temperature for these places during the winter months is between 20° and 30° Fahr.

These figures indicate a mild, equable, and sunshiny climate during winter for all that portion of Florida frequented by invalids, embrac-

ing a region on the east side of the State, from Jacksonville as far south as Palatka. For a country lying on a parallel with the Canaries, off the coast of Africa, they indicate a climate which in temperature approaches that of Malaga, Malta, and Algiers, but does not nearly equal them in evenness and unchangeableness, though, in point of clear, sunshiny weather, far superior.

However, from the facts given, we are unable to fix accurately the position of the Florida climate. We neither know the atmospheric humidity nor the electrical potential; and, as yet, the phenomena of nature have not been interrogated for an answer.

A cardinal question is whether the climate be moist or dry, bracing or relaxing.

It may not be amiss to note here an error committed by a professional gentleman of Jacksonville.* In a pamphlet on the climatology of Florida, he gives tables of the mean relative humidity of Jacksonville and other stations in Florida, and attempts to prove therefrom, by comparison with similar observations in Northern States, that the atmosphere of Florida is *dry*, much drier than that of Minnesota, Mount Washington (New Hampshire), Alpina (Michigan), Omaha (Nebraska), and other Northern localities. It should be remembered, however, that there is a wide difference between *relative humidity* and *absolute humidity*, and their relation is frequently diametrically opposite. Relative humidity does not indicate the amount of vapor present in the air per cubic foot, but only the tendency to deposit it in a wet state on a surface but little lower in temperature than the surrounding atmosphere. Absolute humidity, on the contrary, is the actual amount of vapor present in each cubic foot of air. To illustrate, suppose the cubic foot of air to be a hollow cubic vessel of tin. Absolute humidity is the actual amount of watery vapor contained in that tin vessel. Relative humidity is the tendency of that vapor, be it great or small in quantity, to leak out of the vessel and show itself on the outside in the form of mist or dew. Sir John Herschel says, "As a general meteorological fact, there is not merely a want of accordance, but an actual opposition between both the diurnal and annual progress of the 'degree of humidity' or 'relative humidity' of the air and the 'tension of vapor' as indicated by hygrometric observation, a seeming paradox, but one very easily explained."† He then shows how the relative humidity is greatest just before sunrise of each day, and the vapor tension or absolute humidity is least; that as the day advances the relative humidity diminishes and the absolute humidity increases, till the maximum temperature of the day is reached, when absolute humidity is greatest and relative humidity is least. It is also well to know, in considering this question, that air at a temperature of 60° Fahr. is capable of containing double the quantity of vapor by weight

* Dr. J. C. Kenworthy.

† "Meteorology," by Sir John F. W. Herschel, Edinburgh, 1861, p. 193.

that it is at a temperature of 40° Fahr., and this ratio continues throughout the thermometric scale. Whether air at an average high temperature, like that in Florida, will contain this excess of moisture, depends only on the proximity of water whence the vapor may be obtained.

The figures of relative humidity recorded by the Signal Service at Jacksonville only indicate the ratio in per cent which the humidity of the air at the time bears to *saturated air at the same temperature.* But the weight of vapor in saturated air at that temperature is not given, therefore the absolute value of this percentage, so far as the records are concerned, is unknown. The basis for the calculation is, however, easily obtainable—the weight of vapor in troy grains, contained in saturated air at different temperatures (Glaisher's Table)—and will be found to increase in an ascending scale from zero. The following record of the Signal Service in Cincinnati, Ohio (Sergeant R. B. Watkins, U. S. A., observer), well illustrates the subject:

TEMPERATURE AND HUMIDITY.	7 A.M.	10·30 A.M.	2 P.M.	2·30 P.M.	9 P.M.	10·30 P.M.	Average.
JANUARY 1, 1881:							
Thermometer, degrees Fahr.....	4	12	27·5	29·5	30	28	21·8
Relative humidity, per cent.....	74	61	76	73	68	77	71·5
Actual humidity, grains.....	0·44	0·59	1·35	1·35	1·35	1·41	1·08
JUNE 1, 1881:							
Thermometer, degrees Fahr.....	73	78	79	80	70	69	74·8
Relative humidity, per cent.....	72	61	54	51	80	85	67·1
Actual humidity, grains.....	6·36	6·46	5·95	5·76	6·41	6·57	6·25

From the above table we see that on a day of high temperature and low relative humidity there was nearly six times more vapor in the air than on a day of low temperature and high relative humidity.

By way of comparison we here insert a table showing the mean annual and winter temperature, also the relative humidity and absolute humidity, of three winter stations. It shows the average quantity of vapor in the air at Jacksonville, throughout the year, to be twice as great as at St. Paul, Minnesota, and four times more during the winter season:

STATIONS.*	Altitude.	Annuals.			Winter months: November, December, January, February, March.		
		Temperature.	Relative humidity, per cent.	Absolute humidity, per cubic foot.	Temperature.	Relative humidity, per cent.	Absolute humidity, per cubic foot.
	Feet.	Deg. F.		Grains.	Deg. F.		Grains.
Jacksonville, Florida..	20	68·98	71·0	5·48	58·17	70·6	3·81
San Antonio, Texas....	600	69·6	68·1	5·36	56·63	68·6	3·51
St. Paul, Minnesota....	800	42·32	68·4	2·12	20·17	70·9	0·92

* The temperature of these places is from the "Smithsonian Temperature Tables." The relative humidity is calculated from data of five years—1877–1881 inclusive—supplied the writer by the Chief Signal-Officer, General W. B. Hazen, Washington, D. C.

In consideration of these facts, we are compelled to cast aside tables of "relative humidity" as valueless when taken alone, for the purpose of determining the humidity of climates. The physical properties of vapor in the air—the absolute humidity—are essential elements which can not be ignored, and are of exceeding significance in the treatment of disease.

We have given prominence to this topic, inasmuch as the pamphlet of Dr. Kenworthy is widely circulated by the Bureau of Immigration of the State of Florida, and is quoted in a pamphlet on Florida issued by the United States Department of Agriculture, and also in the well-known work on Florida by G. H. Barbour, as establishing conclusively the dryness of the climate. It well shows how figures, correct in themselves, may, by misapprehension of their import, become the source of mischievous error.

Given—a peninsular land subjected to the burning rays of a semi-tropical sun and surrounded by an ocean of warm water, the average temperature of which is 77° Fahr.*—then it is not necessary to ask the Signal Service whether the climate be moist or dry. If they supplied us with tables of absolute humidity, they could only add to our information accurate knowledge of the excess of moisture. Every breeze that blows touches the face with the softness of a moist May morning at the North. The atmosphere is delicious, balmy.

In addition to physical sensation and deductions drawn from geographical position, there are other reasons for deciding that the climate is moist. The necessity of frequently emptying closets during the summer season, and drying clothing-apparel; the impossibility of using cellars, because of the quickness with which mold destroys goods there stored; the thick formation of *vert-de-gris* on articles of brass; the rapid decay of structures made of wood, as compared with Northern localities; the presence almost everywhere of the Southern moss (*Tillandsia*), swaying in festoons from the trees—these facts tell of excessive atmospheric moisture.

Sunshine, which is so cheering to the invalid, and the absence of which is so depressing even to the well, is abundant in Florida. There it glitters continually on leaf and flower. Five years' observation at Jacksonville shows an average of only seven cloudy days for each winter month, the other twenty-three being arched by a soft Italian-like sky.

What relation electrical potential may have to climate as regards

The absolute humidity is calculated from "Table X" of "Smithsonian Meteorological Tables," by Guyot, giving weight of vapor in grains troy, contained in a cubic foot of saturated air between 0° and 105° Fahr.

* The temperature of the surface-water of the Gulf of Mexico, off Key West, in May, was 77½° Fahr., as determined by the United States Coast Survey, 1857, p. 102.

The average temperature of the St. John's River, at Jacksonville, to the depth of eighteen feet, determined by daily observations by Sergeant J. W. Smith, United States Signal Service, from September, 1881, to March, 1882, is 70° Fahr.

its so-called elasticity or bracing properties is yet undetermined. That it is continually fluctuating, and that it varies considerably at different places, is known. When instruments shall have been devised by which this element can be accurately recorded, we may then discover that those climates which are termed bracing possess special peculiarities as to electrical distribution.

We then estimate the climate of Eastern Florida to be mild in winter temperature, moist, sunshiny, relaxing, and for an American climate equable, though not to be compared in this respect with the Genoese Riviera.

What is the value of this climate in the treatment of disease?

We will first consider that scourge of overcrowded populations—*consumption*—a disease which is limited to no zone, and for which the benefit of change of climate is most frequently sought. The discoveries of Koch, of Berlin, in his researches on the cause of this disease, may, if they are satisfactorily confirmed, enable us in the future to interpose barriers to its invasion. They may also enable us to eliminate "taking cold" as one of the causes of consumption. But they will not change the nature of the *bacillus tuberculosis*, the habits of which, although itself unknown, have been familiar to the world for many centuries. Persons of feeble constitution, whether hereditary or acquired, will still be the subjects of its incursion, and the disease engendered by its presence will require the same treatment as heretofore, unless happily we find a remedy which will destroy these morbific germs *in situ*, and thus, by relieving the patient of the exciting cause, lead to immediate recovery.

It is not necessary to cite authorities to show that the prime need of a consumptive is that he shall be a great deal out-of-doors, that he shall breathe pure air, that he shall exercise, that his entire physical organization shall be invigorated. Is the climate of Florida fitted to do this? I answer, No! The climate is simply and delightfully soothing. Being so—being moist and relaxing—it will cause tuberculous deposits to disintegrate rapidly. Expectoration will be increased, and there will be no rally of the system to oppose this new call upon the strength. Instead of exercising freely and expanding his lungs as he should, the consumptive invalid will sit listlessly on the piazzas of the hotels, awaiting his fate. Hundreds are seen, wherever you go, so doing. Seldom do you see one attempting to exercise, and, if one is seen, he is moving in that sluggish and apathetic manner so characteristic of every one living there.

It is unfortunate that, of the thousands of consumptives who go to Florida, we can get no reliable statistics of the result. The people of Florida, the owners of the soil, the railroad and steamboat owners and agents, the hotel-keepers, the physicians residing there, are all so much interested personally in the prosperity of the State, which, since the close of the war, has been opened up like a newly-discovered country,

that it is well-nigh impossible for them to give unprejudiced statements concerning the healthfulness of the State, its adaptation to the cure of disease, or any other subject, which even remotely touches their personal interest. A prism is placed before your eyes, and you are caused to see everything covered with the colors of the rainbow.

However, I snatched one fragment from the page of fact. During the last six months of 1881 there were thirteen deaths in Jacksonville (population 8,000 *) from consumption, these deaths being of residents only, and excluding all non-residents or visiting invalids. This is a mortality of 1·62 per 1,000, being a greater mortality than occurred in Cincinnati during the same time, which was 4·24 in a population of 280,000, or 1·51 per 1,000. These figures do not establish the rate of mortality, from this disease, in the city of Jacksonville, for in so small a place a series extending over a number of years would be necessary. But, when facts are so difficult to find, we must content ourselves even with a straw. It is much more satisfactory to thus have an indication from a populous center, than the rate from sparsely populated country districts, which, as is well known, are comparatively immune everywhere. It may be stated, in this connection, that natives of Florida taken with consumption frequently seek other places and climates as a means of cure.

In endeavoring to show the unfitness of Florida for consumptives, I have spoken of the disease *en bloc*, and made no reference to the different types, as I believe it better to convey the impression that Florida is not suitable for any type of the disease. Possibly in the rare inflammatory kind, with dry and heated bronchial tubes and beginning laryngeal symptoms, the soothing and relaxing air of Florida may be of temporary advantage. But the forecast of such cases is seen *ab initio*, and we do not look for a cure, such as may frequently occur in cases of the more chronic sort, when proper medicinal treatment is given and a proper climate is selected.

We do not mean to say that cases of consumption never improve in Florida. Undoubtedly there are cases which get well in Florida, just as there are in every locality, and even at home.

Turning from consumption, we will look on the opposite side of the picture. Are there no diseases of the lungs in which this delightful climate is beneficial? Undoubtedly; and it is the efficacy of the climate in this other group of diseases—the bronchial, often wrongly diagnosed as consumption—that has given reputation to the climate. The "taking of cold" in Florida is a comparatively infrequent event. Even when one does take cold it is only manifested by slight sneezing, and that is the end of it. There is no tendency to acute inflammation of the Schneiderian membranes, the extension by continuity to the fauces, larynx, trachea, and bronchial tubes; in fine, to that compound

* The population of Jacksonville, including suburbs, is considerably above this, but the mortality statistics are limited to a district the population of which is as stated.

of *malaise*, difficult breathing, soreness of the chest, and cough, termed a "severe cold," which is so excessively frequent in this latitude, and which, often repeated in certain constitutions, leads to chronic inflammation and diminution of the caliber of the bronchial tubes, to dilatation of air-cells, to bronchorrhœa, and all those attendant evils which are little less baneful than consumption itself. For those in whom frequent colds have induced the condition of *chronic bronchitis*, I believe there is no better climate than Eastern Florida, and those in comparatively good health who suffer from repeated colds without other ill effects will find in that climate freedom from the inconvenience. That other condition termed *winter cough*, frequent among people advanced in years and which is little other than chronic bronchitis with a quiescent period during the summer months, will also be entirely relieved in that land. Indeed, if the person removes there for life he will soon become unconscious that he ever had such an affliction.

Chronic laryngitis, and pharyngitis granulosa, or *clergyman's sore-throat*, will also be decidedly benefited by winter sojourn or permanent residence in Florida.

In the spasmodic constriction of the bronchial tubes—*asthma*—it can only be said that many cases will be entirely relieved in Florida, while with some it will fail, and, if one is to be exiled in the interest of health, there is probably no pleasanter place for enduring semi-expatriation.

A climate of this kind is also favorable to the prolongation of the life of those afflicted with *chronic Bright's disease* of the kidneys—chronic parenchymatous nephritis. The person will be little exposed to chilling of the surface of the body, which arrests cutaneous perspiration, congests the blood-vessels of the internal organs, and forces excessive work on the already damaged cortical net-work of the kidneys.

Sufferers from *muscular* and *chronic rheumatism* find the genial warmth of this region softens the unpliable and painful muscles, and loosens the rigid tendons, while the increased secerning activity of the skin removes the morbid humor, whatever that may be.

For none do I know a land more delightful, than for him who, by long and severe mental activity, has exhausted the vital battery of nerve-force and disturbed the harmonious balance between the varied complex nerve-circuits. The person who suffers from this condition, sometimes called *nervous prostration*, and which often passes under other cognomens, will there find a panacea. The soothing softness of the climate invites to continuous repose, and for him perfect rest is a prelude to restoration; repair of tissue gains upon waste, the nerve-currents gradually resume their normal course and vigor, and a return of health results.

Old age crawls shivering along our cheerless streets, the frigid northern blasts fluttering the garments about his attenuated limbs,

chilling the blood till stasis occurs in some vital organ, and inflammation and death result. There, the old man pursues out-door life fearless of frost or intense heat, and, in a prolonged and painless existence, forgets that his summer is gone, and the snows of winter are upon his head.

In closing this paper, some reference to places in Florida most suitable for invalids may be of interest.

Leaving Jacksonville in the afternoon of any day, by one of the beautiful side-wheel steamers, the passenger, sitting on the forward guard, sees unrolled before him a semi-tropical scene. The vessel makes its way in the midst of a broad stream of placid stillness, whose shoaling shores are curved and fretted by inlet and headland, bearing above them the rich luxuriance of evergreen foliage, like a broad mirror festooned with myrtle and vine. Often, so far away from the course of the boat are the distant shores that one may with difficulty descry the towns and houses which are indicated in the distance. For seventy-five miles and more to the southward the river retains this similitude to a broad and extended lake. Indeed, it seems but a long arm of the sea, the rise and fall of the tide being perceptible even at that distance. Night closes on the journey. During the time you pass through an expanse of the river twelve miles wide and eighteen miles long (Lake George), and when you awake you find the boat in a narrow stream, running beneath the shade of overhanging vines and palmettos, the waters bearing upon their surface a strange, floating, bright-green vegetation, well described by the popular name water-lettuce. Along the shore acres of broad-leaved water-lilies rise and fall with the rapidly-running waves, which surge along the course of the steamer. Here the stream is exceedingly tortuous, and the greatest care is needed on the part of the pilot lest, in turning the acute agles of low-lying land which project to the right and left like alternating narrow blades, his boat will shoot forward beyond his control and fasten itself amid the tangled boughs of a partially submerged forest. This is the paradise of the sportsman, the home of wild ducks and turkeys, and pelicans, and pink curlews.

At a distance of one hundred and ninety miles from Jacksonville another broad expanse of water is entered—Lake Monroe—five miles wide and twelve miles long. On the shore of this lake the boat lands at Sanford, Orange County, which is the head of navigation for large steamers. Beyond this lake the river again diminishes in depth, and is navigable only for very light-draught boats. The origin of the river is in Lake Washington, amid the marshes of the Everglades, two hundred and fourteen miles farther to the south.

There are but few places on the course of the river that are desirable for invalids, on account of the proximity of swamps and danger from malaria. At Sanford I was somewhat amused to see the proprietor of a prominent hotel, which solicits the patronage of invalids, taken with a severe chill while at the desk receiving his guests.

The best places on the river are Magnolia and Green Cove Spring, twenty-eight and thirty miles south of Jacksonville, and Palatka, seventy-five miles from there, each of which possesses superior hotel accommodations, and is subject but little, if at all, to malaria during the winter season.

Gainesville, some forty miles west of Palatka on the line of the Transit Railway, is one of the best locations in the State. It is situated on comparatively high land for Florida, is surrounded by pine-woods, and free from malaria—but, other than as a health resort, has no attractions.

Jacksonville, the center of trade activity, eighteen miles from the mouth of the St. John's, is a city of considerable enterprise. The comforts and conveniences of a Northern city can be obtained there in greater degree than anywhere else in the State. It has, however, in addition, some of the injurious influences which pertain to large cities. There is more danger of typho-malarial diseases and intestinal troubles.

St. Augustine—twenty-five miles south of the mouth of the St. John's, on the coast—that old Spanish town which rests so tranquilly by the sea, looking out over the broad waves of the Atlantic, which roll across from the mother-land, is a most interesting place to the voyager. Its quaint houses, built in the Spanish fashion, from the coquina or imperfectly-formed limestone which is quarried on the beach; its narrow and winding streets, which one may almost cross with a single stride; its old fort, dating from 1696, when Spanish power still ruled a large portion of the world, and Florida was one of the least of its possessions—these, and the many legends which linger around the only moss-covered ruins in America, are the attractions of the place. Long before Jacksonville or any settlement on the St. John's River existed, St. Augustine was noted for its salubrious climate. It is now known, however, that its exposed position on the coast, subjecting it to the whims of every wild northeaster, make it unfitted for very sensitive invalids, though still a favorite resort for several wealthy New York gentlemen of yachting proclivities, who have villas there—and also for those of youthful fervor who cling to romance and sentiment.

A SOUTH AFRICAN ARCADIA.*

By C. G. BÜTTNER.

THE traveler, coming fresh from Europe into Damaraland, is struck by the complete communistic freedom with which every man appropriates the land and its natural products. Roads have been worn

* Translated for "The Popular Science Monthly" from "Das Ausland."

through the thickets by foot-men and the heavy ox-wagons, and the chief villages are connected by a kind of highway, but no one is obliged to keep the roads if he does not want to. They are of no more significance than the zebra or rhinoceros tracks which led to the drinking-places before man appeared in the country; and there is no reason why the traveler should not make a new road at pleasure. The pasturage is free for the teamster's hungry cattle, the wood for the fire needed to cook his supper. If a stray spark sets the grass on fire, no one thinks of complaining; if a hunter commits devastation among the game, the native may grumble at the waste, but he will not imagine that his rights are trespassed upon, or venture to interfere with the proceedings. The game is as much the strange hunter's as his. If one sees a spot that pleases him, he is at liberty to settle upon it, and build himself a house there. If any objection is made to the stranger, nothing worse happens than that something unreasonable is demanded of him, in the same way that people in other parts of the world are not ashamed to overreach strangers: this is not so easily done, however, if the intruder is a native or a member of the same tribe; and even a stranger, if he does not allow himself to be scared away, is at last permitted to remain undisturbed. Whoever settles in any particular spot must, however, expect that other persons, finding it well supplied with water and pasturage, will bring their herds there too; and it is the practice of the Herero, when they wish to get rid of an unwelcome neighbor, notwithstanding their communism, to bring up so many herds and establish so many cattle-ranges about his house that he becomes disgusted with the frequent intrusions, and is obliged to go away from the exhausted tract. Some of the Herero chiefs have recently begun to drive single settlers away by force, but they are actuated by ulterior political views. The people are not disposed to grudge a stranger the particular spot of land he occupies, but they wish to drive foreigners out of the country altogether. An incident from Damara history will help to illustrate the extent to which this sense of communism goes. When the Hereros had succeeded, after nine years of warfare, in shaking off the domination of the Namaquas, to whom they had previously been subjected, the Namaqua chief, Jan Afrikaner, asked the missionaries to help him make a peace with them. The missionaries proposed that the two parties should fix a boundary between themselves, which they would both respect. Both refused to do this. They were ready to make a peace, they said, and keep it, but they would have the land, over which they had fought so hard, in common. The Herero chief, Kamaherero, declared repeatedly that Jan might live in any part of the land he chose after the peace, and that he should expect a fair proportion of his own people to be allowed to live in Jan's land. The peace contracted on these terms lasted fully ten years.

The custom is the same with regard to that which the earth con-

ceals: every one takes of its treasures wherever he finds them. All, from all directions, fetch iron and copper ores from those parts of the land where the mines have been known to exist from time immemorial; and the people who ordinarily live near the mines have never on that account thought of assuming any right of proprietorship over them. There are but few salt-licks in the land; and, as soon after the rainy season as the ground becomes passable, the herders from all quarters drive their cattle across the pasture-lands indifferently to the springs. The dwellers around these places look on quietly, while the cattle and the sheep, flocking up by thousands from all the regions around, tread down and destroy the grass of their pastures. They may complain to themselves about the destruction, but it never occurs to them to drive the strangers away. It would be decidedly foreign to the Damara mind for any one to undertake, as Europeans are accustomed to do, to monopolize the salt-springs and charge a higher price for the use of them as they become more indispensable to others.

The Hereros will even resist, in every way, any one conceding, by sale, a particular right to any person to hold any piece of land. The Roman Catholic missionaries, who recently sought to gain a footing in Damaraland, made themselves suspected more than in any other way by representing to the people that they would do better by them than the Protestant missionaries had done, for they would buy land for their churches, schools, and dwellings, while the Protestant missionaries were occupying land for those purposes free. They ruined their cause, and prompted the heathen chief to try every device to get them away. In a similar manner, the chiefs told us German missionaries, whenever the subject came up, "You may live in our country as long as you wish, and no one shall molest you so long as the land belongs to us, but we will not sell a bit of it to any man."

There are not even any real boundaries between the different tribes. Some of the chiefs have, indeed, set up exclusive claims to particular tracts, but have never assumed to enforce them; and other tribes have never been required to leave the land. The natural result of this communism is, that no one has a personal care for the land, but gets all he can out of it, and then leaves it waste to go to a new spot. Hence the language of the Hereros has no terms for home, fatherland, or boundary-lines.

This communism extends to all the productions of the earth that have not been separated from it. Whatever a man has put his hand upon, that becomes his private property. Whoever takes from a man anything that he has appropriated to his own use, is a thief. Game, free in the fields, belongs to whoever can kill it; but to take it away from a hunter who has bagged it is a theft, or robbery. In Damara law even game which has only been hit, and has afterward been killed by some one else, belongs to the hunter who first hit it, although he is expected to give a share of it to the other one. This feeling is so

strong that, when shooting-parties are made up, the right to the first shot passes from one to another by turns, so that it may be possible for each one to get a piece of game. The hunter who has to make the first shot is in that case the real hunter, and the others are only his helpers; but, if he misses, the right passes over to the next one.

Any one can cut down a tree who wishes to, but another is not allowed to appropriate the wood after it has been taken possession of. Any one may dig a well for his cattle wherever there is hope of finding water, but no one can drink out of the well which another has dug without the permission of the owner. The lord of the well, when he is asked for water, will generally order his people to wait upon the one making the request, so that he does not get paid for the water, but for the attendance; and, if he does not choose to permit the well to be used for another man's cattle, the argument that he did not create the water has no effect upon him. When any one finds a piece of land suitable for a garden, he can fence it and till it, and the crop will belong to him; and it is generally considered wrong for any one to enter upon land that has been put under cultivation by another and till it for himself. But it would be contrary to custom, and provoke resistance, if any one, leaving the place and abandoning his garden, should attempt to sell any right in it. The tract again becomes free for the first comer to occupy.

A kind of property in personal goods is theoretically recognized, but the right is, in practice, one that rather appertains to the family than to the individual. A general principle seems to prevail that it is not right to refuse a gift to one who asks it, particularly if he is a relative or a friend, or is powerful or rich. People of this class have no hesitation in begging, and the stranger may be sure that the ragged fellow who asks him for a new shirt in place of his worn-out one is a person of wealth who thinks he is doing him honor, and is according him the recognition he would give to his lord or his father. The denial of the first request does not generally give offense; but, if the request is granted, the asker will demand more and greater things, and will expect to get them; and, if a person gives to one of a number of beggars, he must give to all the rest, or they will think he is dishonoring them.

The people, however, exercise without scruple the right to appropriate their relative's goods to their own use, if he is not there to prevent it; and this state of public opinion leads to some comical scenes. A wealthy old chief, who had hundreds of dependents, possessed numerous articles of European clothing, without owning a complete suit; but, whenever he went out, he had to put his clothes all on, however hot the weather. He came to me to be photographed one day, having on a pair of shoes, three pairs of thick moleskin trousers, a waistcoat over an indefinite number of shirts, a large shawl around his body, a thick jacket, a shawl around his neck, with a large

dressing-gown over the whole; and on his head a kerchief, a Calabrian cap, and a velvet cap with pearl ornaments; and all this in a heat in which his aboriginal nakedness would have been much more comfortable—because he was afraid, if he left the garments at home, the members of his household would appropriate them. This same chief asked one of my friends for a piece of soap, so that he could wash his clothes himself; for he was afraid, if he gave them to any one else to wash, they would not be returned. If the clothes are locked up in a trunk they will be safe, for it is considered stealing to take them when they are thus secured; but, if the trunk is left open, Damara custom permits the clothes to be lifted carefully out and put one side, and the trunk to be carried off. Articles of personal property may, however, be devoted to special uses, or to special persons, by a kind of form of consecration, when the right to them is respected. A custom of this kind has prevailed from antiquity with reference to cattle and milk-vessels. Frequently, also, the head of the house has the right to the first use of things; among the Hottentots they are his so long as they are whole, but as soon as they are damaged the relatives are at liberty to get them if they can.

New milk must be taken to the master to taste before the rest can partake of it; and this imposes no small labor on the lord of a thousand milch-cows. Likewise whatever is killed must be brought to him first. If he is not at home, the ancestral staff represents him, and must be dipped into the milk or touch the meat. Particular animals are sometimes milked for each member of the family, into a vessel set apart for him, and then it is wrong for any one to touch the dish without the owner's permission. The master's dish is filled even when he is absent, and must not be used by any one else under penalty of bad luck; but, when it is needed for the next milking, the milk already in it is poured out on the ground. If, however, a visitor comes to the place, he, as the master's guest, can use his dish and drink his share of the milk without impropriety. After the owner of the cow and the vessel is dead, the vessel is still regularly filled and emptied, unless some guest comes along to whom the contents can be given.

The principal property of the Herero consists in cattle. As the lambs and calves and the mother-cows are never slaughtered, and other animals only on festal occasions, the herds increase very rapidly in the warm climate of the country, and require constantly larger pasturage tracts. This leads to frequent interferences, with occasions for contention; and at intervals the pasturage becomes exhausted, and great suffering ensues. The Hereros are thus exposed to periodical alternations of wealth and poverty.

The chiefs have, however, a tolerably secure possession in their retainers; and the feudal and patriarchal relation in which the men stand to each other is in strong contrast with the community of title to the land and soil. Theoretically, the function of head of the

family descends to the eldest son; practically, it is exercised by the strongest member of the family—who is most likely an uncle of the heir—around whom the other members group themselves as dependents. The position of the women is not essentially different from that of the women of the working-classes in Europe. The work is divided between the two sexes about as it is in Europe, and the women are not called upon to do men's work, except in case of need, while the men are willing enough to help in the peculiar women's work whenever they can make themselves useful and have nothing better to do, provided no strangers are in sight. Polygamy is freely allowed, and as many alliances as possible are formed by the head of the family, as a means of strengthening his influence and conciliating his neighbors and rivals. The provisions of matrimonial alliances are carefully considered and guarded, so that each family may receive all the honor it is entitled to, and neither shall get the advantage of the other. Slavery exists in a mild form, but the sale of slaves seldom occurs. Children are taken into the council of their parents, and are consulted about important matters from a very early age; and the parent will seldom disregard the advice of his child, or exercise constraint upon him in any matter except indirectly and in the most gentle way.

The most wealthy cattle-owners number their herds by the thousand head. It is impossible to keep them all in one place, and they are therefore distributed at different stations under the charge of particular herdsmen. The herdsman's position is a considerable one, and brings with it privileges enough to make it desirable. The cattle are not distinguished by any specific marks, and the owner's only means of recognizing them is by his personal acquaintance with them. This requires him to be continually on the watch, and to go frequently the round of the stations to inspect them, else his herdsmen might make some of them their own. Most owners become extremely skillful in noticing and recognizing the individual peculiarities of their animals.

The system of inheritance is determined by the circumstances of the country and its customs, which require that the head of the family must be strong and wise enough to maintain his rights. By its operation, when a chief dies and leaves a family of minors, his whole personal estate goes, not to his widow and children, but to the nearest man of might in the family. The cattle and servants become his, and the widow and children become his wife and children, the latter on an equal footing with his own children, so precisely that the language of the country has no word for step-father and step-child. One of the results of the system is that the rich and powerful grow more wealthy and influential the longer they live, while the children and younger members of the family receive nothing as of right. It has, however, become customary for the children to be given particular animals as

their own, their right to which, with the increase, is regularly and formally recognized; and with these and what additions to their stock they may acquire in one way or another, they are able gradually to accumulate a considerable property as they grow up.

The wealth of a man who has grown fat in riches may consist in what he has inherited from his father, or from the chief of his family; in what he has received from more distant relatives; in what he has gained in fees from his herdsmen; and in what of the property of other estates he has received by becoming the head of the family. The line of descent of all this property, which consists almost wholly of the pedigrees of the cattle, is carefully preserved, and the accumulations of each kind can be as carefully computed and allotted as is done in the case of the accounts of European bankers. When the lord dies, all this property, with its increase, must go where it came from. The division, or the fact that it is to take place, brings all the connections of the family from far and wide around the bed of the lord when he has died or is expected to die, for each claimant must be present in person to assert his claim, or it will be overlooked or overpowered. The herdsmen must likewise bring up all the cattle from the various stations, that they may be identified according to their pedigrees. The division of all these animals and the adjudication of the claims of all the pretendants who appear, sometimes consumes months of time, with discussions which are often carried on in the midst of great excitement. The dying man may himself give directions respecting the division of his property, which are then implicitly carried out, otherwise the man who disregards them may be troubled by his ghost.

PIRATICAL PUBLISHERS.

By LEONARD SCOTT.

THE republishers of foreign books and periodicals at cheap rates have long and meekly borne the name which heads this article. I propose to show that they do not also deserve it.

Piracy is robbery in its boldest form, having no warrant but the strength of the bloody hand that commits it. It is against all law and all right, human or divine. It has no sanction nor show of sanction from the practice of others recognized, in all the walks of life, as respectable and honored citizens.

Will this description apply to the reprinting of foreign books? Certainly not. What, then, is the crime of which republishers are guilty? Their calumniators will answer, "Oh! they rob the foreign author of the product of his brain." Let us see if this is true. I grant that if all the nations of the earth had one common interest and

one common government to support it, so that legislation should always be for the mutual advantage of *all* the inhabitants—the same in one section as in another—then the reprinting of a book by or for any one but its author would be a violation of right; but as this Utopia does not and never will exist, we must deal with men, and governments, and their selfishness as we find them. Nations legislate for what they believe to be to their own advantage, and without regard to the interests of their neighbors. Thus, England manufactures goods, and the manufacturer claims that he has a natural right freely to offer these goods as cheaply in one part of the world as in another, save only the cost of conveyance. But do other countries recognize such right? Does this country, for instance, acknowledge it when she lays a heavy duty upon such manufactures? When such duty is so great as to prohibit the importation of a manufactured article that would, if free of duty, sell largely in the United States, is not the manufacturer as effectually robbed as the author whose sales are rendered impossible by a reprint of his book?

Doubtless I shall be told that the cases are not parallel, inasmuch as in the one case the Government of the United States commits the trespass, and in the other its private citizens. I confess I see no difference. Government represents and legislates for its private citizens. Its tariff for revenue furnishes the means which would otherwise have to be taken by direct taxation from the pockets of the people. Its tariff for protection gives encouragement to native manufacturers; the whole system of levying duties upon foreign merchandise is one of pure selfishness, and as much a robbery or piracy of the natural rights of the foreigner as anything yet done by an American republisher. Suppose there were no such market for English books as the United States now offers, would English publishers any the less continue to print them? These works are produced mainly for the markets of Great Britain and its English-speaking dependencies. The withholding of an international copyright law does not take away from them what they never possessed or had any right to claim. The American republisher, therefore, in the absence of such a law, buys the English book at the English price, and thinks he has done all that is required of him to become its absolute owner, to do with it whatever the laws of his country do not forbid. Who shall say that among these rights is not the right to reprint it? "But," say the advocates of copyright, "*inventors* are protected by international *patent-right*, and, if the product of the inventor's brain is entitled to protection, that of the author's is no less so." Here, however, self-interest is again clearly indicated. There was a time when international patent-right did not exist between the United States and Great Britain; but when it became notorious that the inventions of Americans were more numerous and more valuable than those of other countries, our Government willingly consented to international patent-right, and I vent-

ure to say that, when American books shall be as popular in England as English books are in the United States, copyright will no longer be withheld.

It will doubtless be urged that I am placing our government in an unenviable light; that selfishness and not right rules its conduct. I answer that all governments, under like conditions, would pursue a similar course. Great Britain may arrogate to herself national liberality for having opened her ports, with little or no restriction, to the commerce of the world; but the motives which prompted such liberality were as purely selfish as were those of the United States in fettering commerce by her high tariff. Great Britain, assured of her supremacy as the great manufacturer of the world, did not fear the competition of other manufacturers, whether protected or not; and she became, at once, the advocate and the exemplar of free trade, believing that other nations would reciprocate, and thus give greater encouragement to the commerce in which, as a nation, her chief interest lies. Disappointed in her expectations that other countries would follow her example, she is now considering the policy of abandoning "free trade" for what she calls "fair trade," self-interest again prompting this change of attitude toward other nations; and yet she is not in reality any more selfish in the one case than in the other.

Referring again to what is called the *moral wrong* of using the product of another's brain without remuneration, I would ask, "Why this special claim of a foreign author?" Does not our government send experts abroad to gain information on subjects of the greatest importance to our interests at home? Do not these experts closely examine the establishments, public and private, of the Old World and gain all the information possible in regard to them? Do they not visit the great manufactories in all their variety; the workshops, the docks, war-vessels, arsenals, colleges, schools, prisons, hospitals, and churches; and inquire into and observe the modes of foreign life, social, industrial, political, and religious? In short, do they not inform themselves of everything likely to be of benefit to their own country, and, although the information given them may have been the result of centuries of brain-labor, do their countrymen hesitate to appropriate such information to their own use and without pay? The fact is that, the intercommunication of nations gives advantages which isolation could not afford, and if such advantages include the spread of knowledge among the people, obtained either in the way I have here described, or by the cheap reprint of a foreign book, it would be difficult to show anything criminal in thus acquiring it.

In conclusion, it may be well to remark that, even in England, brain-property is not treated like that known as personal or real, for, while the latter has perpetual protection by law, the former has only protection within prescribed limits, the English copyright extending

only for a certain number of years, and it is well known that many of the most valuable standard works, both in prose and poetry, are being continually republished in England without any remuneration to the authors or their heirs. If authors have an inherent right to the products of their brains, the lapse of time should be no reason for taking that right away, and English publishers are as morally guilty of robbery when they fail to make remuneration to such authors or their legal representatives, after the law no longer protects them, as are the American publishers who do the same with English copyright books for which there is no American protection. O most conscientious Briton! when thou doest unto others as thou wouldst that others should do unto thee, then mayst thou, with more consistency, indulge in the abuse of those whom thou delightest to call "piratical publishers."

A CHAPTER IN TRANSCENDENTAL PATHOLOGY.

IN his address to the Pathological Section of the British Medical Association, on the occasion of its meeting at Worcester this year, the distinguished president of the section, Dr. J. Hughlings-Jackson, threw out the suggestion that inflammation should be regarded as a process of dissolution. His meaning will be fully intelligible only to those who have some knowledge of the system of philosophy which Mr. Herbert Spencer has given to the world. It may be interesting, both to those who are familiar with Mr. Spencer's writings, and to those who are not, if we somewhat expand Dr. Jackson's hint, and inquire briefly how far inflammation corresponds to Mr. Spencer's definition of dissolution. If we find that it is included in that definition, it may enable us to trace relations between inflammation and other allied processes—mineral, vegetal, animal, psychological, and social—which can not but enlarge and make clearer our views of it and them.

Evolution, our readers will hardly need reminding, is the process of growth and life; *dissolution*, that of decay and death. The definition of inflammation which is given by one of the most eminent writers upon the subject starts from the proposition that inflammation is the result of injury. We should, therefore, *a priori*, expect that changes which are the result of injury would have their analogues rather in the processes of decay and death than in those of life and growth. The definition of evolution which Mr. Spencer formulates is as follows: "Evolution is an integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity, and during which the retained motion undergoes a parallel transformation."

Dissolution is the reverse of this. We have, then, to see if inflammation corresponds to a definition running thus: Dissolution is a disintegration of matter and concomitant absorption of motion, during which the matter passes from a definite, coherent heterogeneity to an indefinite, incoherent homogeneity, and during which the retained motion undergoes a parallel transformation.

The first thing which our definition asserts is, that inflammation is a disintegration of matter. This proposition needs little defense. Do we not find that inflamed parts are always softened, and that when the process is severe and continued they become liquefied, converted into pus? Inflammation clearly is a process which tends to the disintegration of matter. We learn, next, that the disintegration of matter is accompanied with concomitant absorption of motion. This, on consideration, will be found equally true, although, perhaps, not so obvious. In the process of evolution the motion of units (molecular motion) becomes converted into the motion of aggregates (molar motion); and in dissolution the reverse takes place. The latter we shall find hold good of inflammation. An inflamed part is not only softened—which means that its component molecules move more readily upon one another—but it is swollen. The particles previously integrated into a solid mass, occupying a small space, have most of them moved farther away from one another, and now occupy a comparatively great space. Besides this, it is hotter than natural, and heat is a mode of motion. There is thus an increase of molecular motion. With this, the functional activity of the part which, from our present point of view, is its motion as an aggregate (for all force is a mode of motion), is lessened. To take the most literal illustration: an inflamed muscle can not contract with the force of a healthy one. Seeing, then, that there is an increase of molecular motion in an inflamed part, we might be content with pointing out that this motion must have been obtained from somewhere. But we may go further. There is one remedy, the potency of which, in checking inflammatory change, can not be gainsaid. It can not everywhere be efficiently applied, and it is not always decidedly for the patient's benefit that inflammation should be too rudely cut short; but, when circumstances admit of cold being brought into play, there is no doubt that it will arrest or suspend inflammatory change. We find throughout the universe that cold everywhere arrests molecular motion. It makes fluids into solids, vapors into fluids; checks chemical as well as vital change. The inflamed part to which cold is applied is surrounded by a medium from which it can not absorb motion; and, if motion can not be absorbed, inflammation can not go on. Inflammation, then, is a change attended with the absorption of motion as well as with the disintegration of matter.

Proceeding with our definition, we find it next informs us that the matter (in the present case the inflamed part) passes from a definite, coherent heterogeneity to an indefinite, incoherent homogeneity. It

is a general assertion that holds good of inflammation in every part of the body, that from the first stage to the last it tends to blend and confuse together, to destroy the distinctive features of the individual structures of the part affected. In the beginning we have infiltration with leucocytes, replacing with cells of indefinite type the muscular, nervous, fibrous, and other naturally well-defined elements of the part affected. Finally, we have every trace of the latter lost; the definiteness of structure, its coherence and heterogeneity have gone, and we have in place simply a collection of fluid homogeneous pus. The progress is clearly from the definite, the coherent, and the heterogeneous, to the indefinite, the incoherent, and the homogeneous. The last part of the definition asserts that the retained motion undergoes a like transformation. This we have partly touched on already. The healthy body contains structures which absorb, transform, and give out force—that is, motion—in different ways. By the intestinal canal, force stored up by plants and animals is taken into the body. By the lymphatic and vascular system it is transferred from the place where it is taken in to the place where it is wanted for use. By the nervous, muscular, and glandular apparatus it is converted into sensible motion of the organism as a whole, or into secretions capable of setting up various changes in the substances with which they come in contact, or of producing and nourishing a new being. We have, therefore, in the normal organism, motion given out in many heterogeneous forms, each form being definite, and each so related to the activity of the rest that the body forms a whole as coherent in function as it is in structure. When inflammation affects a part, these features of its dynamic activity disappear. Natural function is either lost, or performed only in an imperfect way. In place of the exertion of force in ways heterogeneous, but definite, we have the homogeneous molecular motion manifested by liquefaction, swelling, and warmth. Definiteness of function, as of structure, is lost; heterogeneity of tissue-changes, as of the tissues themselves, is altered to homogeneity; and in place of the part fulfilling its function to the advantage of every other part, that is, in a manner coherent with functional activity elsewhere, it exercises only a perturbing, injurious effect—its functional activity has become incoherent instead of coherent.

The subject is a very large one; and in the space that we are able to give to it we can not do more than imperfectly indicate the analogies which inflammatory changes bear to those of dissolution generally. If our remarks should incite others to follow up the subject in a more exact and comprehensive manner, our object in making them will have been amply fulfilled.—*Medical Times and Gazette.*

THE PEDIGREE OF WHEAT.

By Professor GRANT ALLEN.

WHEAT ranks by origin as a degenerate and degraded lily. Such in brief is the proposition which this paper sets out to prove, and which the whole course of evolutionary botany tends every day more and more fully to confirm. By thus from the very outset placing clearly before our eyes the goal of our argument, we shall be able the better to understand as we go whither each item of the cumulative evidence is really tending. We must endeavor to start with the simplest forms of the great group of plants to which the cereals and the other grasses belong, and we must try to see by what steps this primitive type gave birth, first to the brilliantly colored lilies, next to the degraded rushes and sedges, and then to the still more degenerate grasses, from one or other of whose richer grains man has finally developed his wheat, his rice, his millet, and his barley. We shall thus trace throughout the whole pedigree of wheat from the time when its ancestors first diverged from the common stock of the lilies and the water-plantains, to the time when savage man found it growing wild among the untilled plains of prehistoric Asia, and took it under his special protection in the little garden-plots around his wattled hut, whence it has gradually altered under his constant selection into the golden grain that now covers half the lowland tilth of Europe and America. There is no page in botanical history more full of genuine romance than this; and there is no page in which the evidence is clearer or more convincing for those who will take the easy trouble to read it aright.

The fixed point from which we start is the primitive and undifferentiated ancestral flowering plant. Into the previous history of the line from which the cereals are ultimately descended, I do not propose here to enter. It must suffice for our present purpose to say dogmatically that the flowering plants as a whole derive their origin from a still earlier flowerless stock, akin in many points to the ferns and the club-mosses, but differing from them in the relatively important part borne in its economy by the mechanism for cross-fertilization. The earliest flowering plant of the great monocotyledonous division (the only one with which we shall here have anything to do) started apparently by possessing a very simple and inconspicuous blossom, with a central row of three ovaries, surrounded by two or more rows of three stamens each, without any colored petals or other ornamental adjuncts of any sort. I need hardly explain even to the unbotanical reader at the present day that the ovaries contain the embryo seeds, and that they only swell into fertile fruits after they have been duly impregnated by pollen from the stamens, preferably those of another

plant, or at least of another blossom on the same stem. Seeds fertilized by pollen from their own flower, as Mr. Darwin has shown, produce relatively weak and sickly seedlings; seeds fertilized by pollen from a sister plant of the same species produce relatively strong and hearty seedlings. The two cases are exactly analogous to the effects of breeding in and in or of an infusion of fresh blood among races of men and animals. Hence it naturally happens that those plants whose organization in any way favors the ready transference of pollen from one flower to another gain an advantage in the struggle for existence, and so tend on the average to thrive and to survive; while those plants whose organization renders such transference difficult or impossible stand at a constant disadvantage in the race for life, and are liable to fall behind in the contest, or at least to survive only in the most unfavorable and least occupied parts of the vegetal economy. Familiar as this principle has now become to all scientific biologists, it is yet so absolutely necessary for the comprehension of the present question, whose key-note it forms, that I shall make no apology for thus once more stating it at the outset as the general law which must guide us through all the intricacies of the development of wheat.

Our primitive ancestral lily, not yet a lily or anything else namable in our existing terms, had thus, to start with, one triple set of ovaries, and about three triple sets of pollen-bearing stamens; and to the very end this triple arrangement may be traced under more or less difficult disguises in every one of its numerous modern descendants. No single survivor, however, now represents for us this earliest ideal stage; we can only infer its existence from the diverse forms assumed by its various divergent modifications at the present day, all of which show many signs of being ultimately derived from some such primordial and simple ancestor. The first step in advance consisted in the acquisition of petals, which are now possessed in a more or less rudimentary shape by all the tribe of trinary flowers, or at least, if quite absent, are shown to have been once present by intermediate links or by abortive rudiments. There are even now flowers of this class which do not at present possess any observable petals at all; but these can be shown (as we shall see hereafter) not to be unaltered descendants of the prime type, but on the contrary to be very degraded and profoundly modified forms, derived from later petal-bearing ancestors, and still connected with their petal-bearing allies by all stages of intervening degeneracy. The original petalless lily has long since died out before the fierce competition of its own more advanced descendants; and the existing petalless reeds or cuckoo-pints, as well as the apparently petalless wheats and grasses, are special adaptive forms of the newer petal-bearing rushes and lilies.

The origin of the colored petals is almost certainly due to the selective action of primeval insects. The soft pollen, and perhaps, too, the slight natural exudations around the early flowers, afforded food to

the ancestral creatures not then fully developed into anything that we could distinctively call a bee or a butterfly. But, as the insects flew about from one head to another in search of such food, they carried small quantities of pollen with them from flower to flower. This pollen, brushed from their bodies on to the sensitive surface of the ovaries, fertilized the embryo seeds, and so gave the fortunate plants which happened to attract the insects all the benefits of a salutary cross. Accordingly, the more the flowers succeeded in attracting the eyes of their winged guests, the better were they likely to succeed in the struggle for existence. In some cases, the outer row of stamens appears to have become flattened and petal-like, as still often happens with plants in the rich soil of our gardens; and in these flatter stamens the oxidized juices assumed perhaps a livelier yellow than even the central stamens themselves. If the flowers had fertilized their own ovaries this change would of course have proved disadvantageous, by depriving them entirely of the services of one row of stamens; for the new flattened and petal-like structures lost at once the habit of producing pollen. But their value as attractive organs for alluring the eyes of insects more than counterbalanced this slight apparent disadvantage; and the new petal-bearing blossoms soon outstripped and utterly lived down all their simpler petalless allies. By devoting one outer row of stamens to the function of alluring the fertilizing flies, they have secured the great benefit of perpetual cross-fertilization, and so have got the better of all their less developed competitors. At the same time, the exudations at the base of the petals have assumed the definite form of sweet nectar or honey, a liquid which is mainly composed of sugar, that universal allurer of animal tastes. By this means the plants save their pollen from depredations, and at the same time offer the insects a more effectual, because a more palatable, sort of bribe.

Passing rapidly over these already familiar initial stages, we may go on to those more special and distinctive facts which peculiarly concern the ancestry of the lilies and cereals. It is probable that the nearest modern analogue of the earliest petal-bearing trinary flowers is to be found in the existing alisma tribe, including our own English arrowheads and flowering rushes. As a rule, indeed, it may be said that fresh-water plants and animals tend to preserve for us very ancient types indeed; and all the alismas are marsh or pond flowers of an extremely simple character. They have usually three greenish sepals outside each blossom, inclosing one whorl of three white or pink petals, two or three whorls of three stamens each, and a number of separate ovaries, which are not united, as in the more developed true lilies, into a single capsule, but remain quite distinct, each with its own individual stigma or sensitive surface. Even within this relatively early and simple group, however, several gradations of development may yet be traced. I incline to believe that our English smaller alisma, a not un-

common plant in wet ditches and marshes throughout the whole of Southern Britain, represents the very earliest petal-bearing type in this line of development; indeed, save that its petals are now pinky-white, while those of the original ancestor were almost certainly yellow, we might almost say that the marsh-weed in question was really the earliest petal-bearing plant of which we are in search. It closely resembles in appearance, and in the arrangement of its parts, the buttercups, which are the earliest existing members of the other or quinary division of flowering plants; and in both we seem to get a survival of a still earlier common ancestor, only that in the one the parts are arranged in rows of three, while in the other they are arranged in rows of five; and concomitantly with this distinction go the two or three other distinctions which mark off the two main classes from one another—namely, that the one has leaves with parallel veins, only one seed-leaf to the embryo, and an endogenous stem, while the other has leaves with netted veins, two seed-leaves to the embryo, and an exogenous stem. Nevertheless, in spite of such fundamental differences, we may say that the alismas and the buttercups really stand very close to one another in the order of development. When the two main branches of flowering plants first diverged from one another, the earliest petal-bearing form they produced on one divergent branch was the alisma, or something very like it; the earliest petal-bearing form they produced on the other divergent branch was the buttercup, or something very like it. Hence, whenever we have to deal with the pedigree of either great line, the fixed historical point from which we must needs set out must always be the typical alismas or the typical buttercups. The accompanying diagram will show at once the relation of parts in the simplest trinary flowers, and will serve for comparison at a later stage of our argument with the arrangement of their degraded descendants, the wheats and grasses.

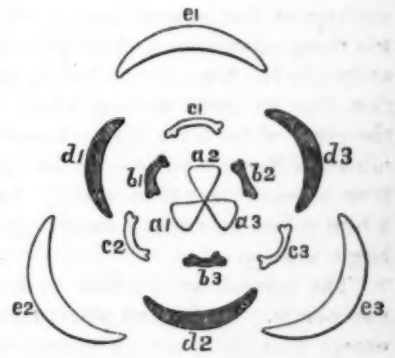

FIG. 1.—*a*, ovaries; *b*, stamens, inner whorl; *c*, stamens, outer whorl; *d*, petals; *e*, calyx-pieces.

Our own smaller alisma has a number of ovaries loosely scattered about in its center, as in the buttercups, with two rows of three stamens outside them, and then a single row of three petals, followed by the calyx or inclosing cup of three green pieces. Its close ally the water-plantain, however, shows signs of some advance toward the typical lily form in the arrangement of its ovaries in a single ring, often loosely divisible into three sets. And in the pretty pink flowering rush (not of course a rush at all in the scientific sense) the advance

is still more marked in that the number of ovaries is reduced to six, that is to say, two whorls of three each, accompanied by nine stamens, similarly divisible into three rows. In all these very early forms (as in their analogues the buttercups) the main point to notice is this, that there is as yet no regular definiteness in the numerical relations of the parts. They tend to run, it is true, in rows of three; but often these rows are so numerous and so confused that nature loses count, so to speak, and it is only in their higher and more developed members that we begin to arrive at any distinct symmetry, such as that of the flowering rush. Even here, the symmetry is far from being so perfect as in the later lilies. There are, however, a few very special members of the alisma family in which the approach to the true lilies is even greater. These are well represented in England by our own common arrowgrasses—inconspicuous little green flowers, with three calyx-pieces, three petals, six stamens, and either six or three ovaries. Here, too, the ovaries are at first united into a single pistil (as it is technically called), though they afterward separate as they ripen into three or six distinct little capsules. One of our British kinds, the marsh arrowgrass, has almost reached the lily stage of development; for it has three calyx-pieces, three petals, six stamens, and three ovaries, exactly like the true lilies; but it falls short of their full type in the fact that its pistil divides when ripe into separate capsules, whereas the pistil of the lilies always remains united to the very end; and this minute difference suffices, in the eyes of systematic botanists, to make it an alisma rather than a lily. In reality, it ought to be regarded as a benevolent neutral—a surviving intermediate link between the two larger classes.

The specialization which makes the true lilies thus depends upon two points. In the first place, all the parts are regularly symmetrical, except that there are two rows of stamens to each one of the other organs: the common formula being three calyx-pieces, three petals, six stamens, and three ovaries. In the second place, the three ovaries are completely combined together into a single three-celled pistil. The advantage which the lilies thus gain is obvious enough. Their bright petals, usually larger and more attractive than those of the alismas, allure a sufficient number of insects to enable them to dispense with the numerous stamens and ovaries of their primitive ancestors. Moreover, this diminution in number is accompanied by an increase in effectiveness and specialization: for the lilies have only three sensitive surfaces to their pistil, combined on a single stalk; and the honey is usually so placed at its base that the insect can not fail to brush off pollen at every visit against all three surfaces at once. Again, while the number of ovaries has been lessened, the number of seeds in each has been generally increased, which also marks a step in advance, since it allows many seeds to be impregnated by a single act of pollination. The result of all these improvements, carried further by

some lilies than by others, is that the family has absolutely outstripped all others of the trinary class in the race for the possession of the earth, and has now occupied all the most favorable positions in every part of the world. While the alismas and their allies have been so crowded out that they now linger only in a few ponds, marshes, and swamps, to which the more recent lily tribe have not yet had time fully to adapt themselves, the true lilies and their yet more advanced descendants have taken seizin of every climate and every zone upon our planet, and are to be found in every possible position, from the arborescent yuccas and huge agaves of the tropics to the wild hyacinths of our English woodlands and the graceful asphodels of the Mediterranean hill-sides.

The lilies themselves, again, do not all stand on one plane of homogeneous evolution. There are different grades of development still surviving among the class itself. The little yellow gagea which grows sparingly in sandy English fields may be taken as a very fair representative of the simplest and earliest true lily type. It bears a small bunch of little golden flowers, only to be distinguished from the higher alismas by their united ovaries: for though both calyx and petals are here brightly colored, that is also the case in the flowering rushes, and in many others of the alisma group. On the other hand, though it may be said generally of the lilies that their calyx and petals are colored alike—sometimes so much so as to be practically indistinguishable—yet there are many kinds which still retain the greenish calyx-pieces, and that even in the more developed genera. But most of the lilies are far handsomer than gagea and its allies: even in England itself we have such very conspicuous and attractive flowers as the purple fritillaries, which every Oxford man has gathered by handfuls in the spongy meadows about Iffley lock, with their dark spotted petals converging into a bell, and the nectaries at the base producing each a large drop of luscious honey. Some, like our wild hyacinths, have assumed a tubular shape under stress of insect selection, the better to promote proper fertilization; and at the same time have acquired a blue pigment, to allure the eyes of azure-loving bees. Others have become dappled with spots to act as honey-guides, or have produced brilliant variegated blossoms to attract the attention of great tropical insects. Our British lilies alone comprise such various examples as the lily-of-the-valley, a tubular, white, scented species, adapted for fertilization by moths; the very similar Solomon's-seal; the butcher's-broom; the wild tulip; the star-of-Bethlehem; the various squills; the asparagus; the grape-hyacinth; and the meadow-saffron. Some of them (for example, asparagus and butcher's-broom) have also developed berries in place of dry capsules; and these berries, being eaten by birds which digest the pulp, but not the actual seeds, aid in the dispersion of the seedlings, and so enable the plant to reduce the total number of seeds to three only, or one in each

ovary. Among familiar exotics of the same family may be mentioned the hyacinth, tuberose, tulip, asphodel, yucca, and most of the so-called lilies. In short, no tribe supplies us with a greater number of handsome garden flowers, for the most part highly adapted to a very advanced type of insect fertilization.

Properly to understand the development of our existing wheat from this brilliant and ornamental family, as well as to realize the true nature of its relation to allied orders, we must first glance briefly at the upward evolution of the other branches descended from the true lilies, and then recur to the downward evolution which finally resulted in the production of the degenerate grasses. In the main line of progressive development, the lilies gave origin to the amaryllids, familiarly represented in England by the snow-drops and daffodils, a family which is technically described as differing from the lilies in having an inferior instead of a superior ovary—that is to say, with the pistil apparently placed below instead of above the point where the petals and calyx-pieces are inserted. From the evolutionary point of view, however, this difference merely amounts to saying that the amaryllids are tubular lilies, in which the tube has coalesced with the walls of the ovary, so that the petals seem to begin at its summit instead of at its base. The change gives still greater certainty of impregnation, and therefore benefits the race accordingly. At the same time, the amaryllids, being probably a much newer development than the true lilies, have not yet had leisure to gain quite so firm a footing in the world; though on the other hand many of them are far more minutely adapted for special insect fertilization than their earlier allies. They include the so-called Guernsey lilies of our gardens, as well as the huge American aloes which all visitors to the Riviera know so well on the dry hills around Nice and Cannes. The iris family are a similar but rather more advanced tribe, with only three stamens instead of six, their superior organization allowing them readily to dispense with half their complement, and so to attain the perfect trinary symmetry of three sepals, three petals, three stamens, and three ovaries. Among them, the iris and the crocus are circular in shape, but some very advanced types, such as the gladiolus, have acquired a bilateral form, in correlation with special insect visits. From these, the step is not great to the orchids, undoubtedly the highest of all the trinary flowers, with the triple arrangement almost entirely obscured, and with the most extraordinary varieties of adaptation to fertilization by bees or even by humming-birds in the most marvelous fashions. Alike by their inferior ovary, their bilateral shape, their single stamen, their remarkable forms, their brilliant colors, and their occasional mimicry of insect-life, the orchids show themselves to be by far the highest of the trinary flowers, if not, indeed, of the entire vegetable world.

From this brief sketch of the main line of upward evolution from lilies to orchids, we must now return to the grand junction afforded

us by the lilies themselves, and travel down the other line of degeneracy and degradation which leads us on to the grasses and the cereals, including at last our own familiar cultivated wheat. Any trinary flower with three calyx-pieces, three petals, six stamens, and a three-celled pistil not concealed within an inclosing tube, is said to be a lily, as long as it possesses brightly colored and delicate petals. There are, however, a large number of somewhat specialized lilies with very small and inconspicuous petals, which have been artificially separated by botanists as the rush family, not because they were really different in any important point of structure from the acknowledged lilies, but merely because they had not got such brilliant and handsome blossoms. These despised and neglected plants, however, supply us with the first downward step on the path of degeneracy which leads at last to the grasses, and they may be considered as intermediate stages in the scale of degradation, fortunately preserved for us by exceptional circumstances to the present day. Even among the true lilies, there are some, like the garlic and onion tribe, which show considerable marks of degeneration, owing to some decline from the type of insect fertilization to the undesirable habit of fertilizing themselves. Thus, while our common English rampsons or wild garlic has pretty and conspicuous white blossoms, some other members of the tribe, such as the crow allium, have very small greenish flowers, often reduced to mere shapeless bulbs. Among the true rushes, however, the course of development has been somewhat different. These water-weeds have acquired the habit of trusting for fertilization to the wind, which carries the pollen of one blossom to the sensitive surface of another, perhaps at less trouble and expense to the parent plant than would be necessary for the allurement of bees or flies by all the bribes of brilliant petals and honeyed secretions. To effect this object, their stamens hang out pensile to the breeze, on long, slender filaments, so lightly poised that the merest breath of air amply suffices to dislodge the pollen: while the sensitive surface of the ovaries is prolonged into a branched and feathery process, seen under the microscope to be studded with adhesive glandular knobs, which readily catch and retain every golden grain of the fertilizing powder which may chance to be wafted toward them on the wings of the wind. Under such circumstances, the rush kind could only lose by possessing brightly colored and attractive petals, which would induce insects uselessly to plunder their precious stores: and so all those rushes which showed any tendency in that direction would soon be weeded out by natural selection; while those which produced only dry and inconspicuous petals would become the parents of future generations, and would hand on their own peculiarities to their descendants after them. Thus the existing rushes are all plain little lilies with dry, brownish flowers, specially adapted to wind-fertilization alone.

Among the rushes themselves, again, there are various levels of

retrogressive development—retrogressive, that is to say, if we regard the lily family as an absolute standard: for the various alterations undergone by the different flowers are themselves adaptive to their new condition, though that condition is itself decidedly lower than the one from which they started. The common rush and its immediate congeners resemble the lilies from which they spring in having several seeds in each of the three cells which compose their pistil. But there is an interesting group of small grass-like plants, known as wood-rushes, which combine all the technical characteristics of the true rushes with a general character extremely like that of the grasses. They have long, thin, grass-like blades in the place of leaves; and, what is still more important, as indicating an approach to the essentially one-seeded grass tribe, they have only three seeds in the flower, one to each cell of the capsule. These seeds are comparatively large, and are richly stored with food-stuffs for the supply of the young plantlet. One such richly supplied embryo is worth many little unsupported grains, since it stands a much better chance than they do of surviving in the struggle for existence. The wood-rushes may thus be regarded as some of the earliest plants among the great trinary class to adopt those tactics of storing gluten, starch, and other food-stuffs along with the embryo, which have given the cereals their acknowledged superiority as producers of human food. They are closely connected with the rushes, on the one hand, by sundry intermediate species which possess thin leaves instead of cylindrical, pithy blades; and they lead on to the grasses, on the other, by reason of their very grass-like foliage, and their reduced number of large, well-furnished, starchy seeds.

In another particular, the rush family supplies us with a useful hint in tracing out the pedigree of the grasses and cereals. Their flowers are, for the most part, crowded together in large tufts or heads, each containing a considerable number of minute separate blossoms. Even among the true lilies we find some cases of such crowding in the hyacinths and the squills, or, still better, in the onion and garlic tribe. But, with the wind-fertilized rushes, the grouping together of the flowers has important advantages, because it enables the pollen more easily to fix upon one or other of the sensitive surfaces, as the stalks sway backward and forward before a gentle breeze. Among yet more developed or degraded wind-fertilized plants, this crowding of the blossoms becomes even more conspicuous. A common American rush-like water-plant, known as eriocaulon, helps us to bridge over the gap between the rushes and such compound flowers as the sedges and grasses. Eriocaulon and its allies have always one seed only in each cell of the pistil; and they have also generally a very delicate corolla and calyx, of from four to six pieces, representing the original three sepals and three petals of the lilies and rushes. But their minute blossoms are closely crowded together in globular heads, the stamens and pistils being here divided in separate flowers, though both kinds

of flowers are combined in each head. From an ancestral form not unlike this, but still more like the wood-rushes, we must get both our sedges and our grasses. And though the sedges themselves do not stand in the direct line of descent to wheat and the other cereals, they are yet so valuable as an illustration from their points of analogy and of difference that we must turn aside for a moment to examine the gradual course of their evolution.

The simplest and most primitive sedges now surviving, though very degenerate in type, yet retain some distinct traces of their derivation from earlier rush-like and lily-like ancestors. In the earliest existing type, known as scirpus, the calyx and petals, which were brightly colored in the lilies, and which were reduced to six brown scales in the rushes, have undergone a further degradation to the form of six small, dry bristles, which now merely remain as rudimentary relics of a once useful and beautiful structure. In some species of scirpus, too, the number of these bristles is reduced from six to four or three. There is still one whorl of three stamens, however; but the second whorl has disappeared; while the pistil now contains only one seed instead of three; though it still retains some trace of the original three cells in the fact that there are three sensitive surfaces, united together at their base into one stalk or style. Each such diminution in the number of seeds is always accompanied by an increase in the effectiveness of those which remain; the difference is just analogous to that between the myriad ill-provided eggs of the cod, whose young fry are for the most part snapped up as soon as hatched, and the two or three eggs of birds, which watch their brood with such tender care, or the single young of cows, horses, and elephants, which guard their calves or foals almost up to the age of full maturity. What the bird or the animal effects by constant feeding with worms or milk, the plant effects by storing its seed with assorted food-stuffs for the sprouting embryo.

In the more advanced or more degenerate sedges we get still further differentiation for the special function of wind-fertilization. Take as an example of these most developed types, on this line of development, the common English group of carices. In these the flowers have absolutely lost all trace of a perianth (that is to say, of the calyx and petals), for they do not possess even the six diminutive bristles which form the last relics of those organs in their allies, the scirpus group. Each flower is either male or female—that is to say, it consists of stamens or ovaries alone. The male flowers are represented by a single scale or bract, inclosing three stamens; and in some species even the stamens are reduced to a pair, so that all trace of the original trinary arrangement is absolutely lost. The female flowers are represented by a single ovary, inclosed in a sort of loose bag, which may perhaps be the final rudiment of a tubular, bell-shaped corolla like that of the hyacinth. This ovary contains a single seed, but its shape is often

triangular, and it has usually three stigmas or sensitive surfaces, thus dimly pointing back to the three distinct cells of its lily-like ancestors, and the three separate ovaries of its still earlier alisma-like progenitors. In many species, however, even this last souvenir of the trinary type has been utterly obliterated, the ovary having only two stigmas, and assuming a flattened, two-sided shape. In all the carices the flowers are loosely arranged in compact spikes and spikelets, with their mobile stamens hanging out freely to the breeze, and their feathery stigmas prepared to catch the slightest grain of pollen which may happen to be wafted their way by any passing breath of air. The varieties in their arrangement, however, are almost as infinite among the different species as those of the grasses themselves; sometimes the male and female flowers are produced on separate plants; sometimes they grow in separate spikes on the same plant; sometimes the same spike has male flowers at the top and female at the bottom; sometimes the various flowers are mixed up with one another at top and bottom, a regular hotch-potch of higgledy-piggledy confusion. But all the sedges alike are very grass-like in their aspect, with thin blades by way of leaves, and blossoms on tall heads, as in the grasses. In fact, the two families are never accurately distinguished by any except technical botanists; to the ordinary observer, they are all grasses together, without petty distinctions of genus and species. Like the grasses, too, the sedges are mostly plants of the open, wind-swept plains or marshy levels, where the facilities for wind-fertilization are greatest and most constantly present.*

And now, from this illustrative digression, let us hark back again to the junction-point of the rushes, whence alike the sedges and the grasses appear to diverge. In order to understand the nature of the steps by which the cereals have been developed from rush-like ancestors, it will be necessary to look shortly at the actual composition of the flower in grasses, which is the only part of their organism differing appreciably from the ordinary lily type. The blossoms of grasses, in their simplest form, consist of several little green florets, arranged in small clusters, known as spikelets, along a single common axis. Of this arrangement, the head of wheat itself offers a familiar and excellent example. If we pull to pieces one of the spikelets composing such a head, we find it to consist of four or five distinct florets. Omitting special features and unnecessary details, we may say that each floret is made up of two chaffy scales, known as pales, and representing the calyx, together with a pair of small white petals known as lodicules, three stamens, and an ovary with two feathery styles. Moreover, the two pales or calyx-pieces are not similar and symmet-

* The sedges are not, in all probability, a real natural family, but are a group of heterogeneous, degraded lilies, containing almost all those kinds in which the reduced florets are covered by a single conspicuous glume-like bract. It will be seen from the sequel that these bracts are not truly analogous to the glumes or outer palem of grasses.

rical, for the outer one is simple and convex, while the inner one is apparently double, being made up of two pieces rolled into one, and still possessing two green midribs, which show distinctly like ribs on its flat outer surface. Here, it will immediately be apparent, the traces of the original trinary arrangement are very slight indeed.

But when we come to inquire into the rationale and genesis of these curiously one-sided flowers, it is not difficult to see that they have been ultimately derived from trinary blossoms of the rush-like type. The first and most marked divergence from that type, for which the analogy of the sedges has already prepared us, is the reduction of the ovary to a single one-seeded cell, whose ripe, fruity form is known as a grain. At one time, we may feel pretty sure, there must have existed a group of nascent grasses, which only differed from the wood-rush genus in having a single-celled ovary instead of a three-celled pistil with one seed in each cell; and even the ovary of this primitive grass must have retained one mark of its trinary origin in its possession of three styles to its one grain, thus pointing back (as most sedges still do) to its earlier rush-like origin. That hypothetical form must have had three sepals, three petals, six stamens, and one three-styled ovary. But the peculiar shape of modern grass-flowers is clearly due to their very spiky arrangement along the edge of the axis. In the wood-rushes and the sedges, we see some approach to this condition; but in the grasses, the crowding is far more marked, and the one-sidedness has accordingly become far more conspicuous. Suppose we begin to crowd a number of wind-fertilized lily-like flowers along an axis in this manner, taking care that the stamens and the sensitive feathery styles are always turned outward to catch the breeze (for otherwise they will die out at once), what sort of result shall we finally get?

In the first place, the calyx, consisting of three pieces, will stand toward the crowded stem or axis in such a fashion that one piece will be free and exterior, while two pieces will be interior and next the stem, thus:

O
a a
a

Now, the effect of constant crushing in this direction will be that the two inner calyx-pieces will be slowly dwarfed, and will tend to coalesce with one another; and this is what has actually happened with the inner pale of wheat and of other grasses, though the midribs of the two originally separate pieces still show on the compound pale, like dark-green lines down its center. Thus, in the fully developed grasses, in place of a trinary calyx, we get two chaffy scales or pales, the outer one representing a single sepal, and the inner one, which has been dwarfed by pressure against the stem, representing two sepals rolled

into one, with two midribs still remaining as evidence of their original distinctness.

Next, in the case of the petals, which alternate with the sepals of the calyx, the relation to the stem is exactly reversed; for we have here two petals free and exterior, with one interior petal crowded closely against the axis, thus:

O
a
a a

Here, then, the two external petals will be saved, exactly as the one external sepal was saved in the case of the calyx; and these two petals are represented by the very small white lodicules under the outer pale in our existing wheats and grasses. On the other hand, the inner petal, jammed in between the grain and the inner pale (with the stem at its back), has been utterly crushed out of existence, partly because of its very small size, partly because of its functional uselessness, and partly because it had no other part with which to coalesce, and so to save itself as the inner sepals had managed to do. Moreover, it must be remembered that the sepals do still perform a useful service in protecting the young flower before it opens, and in keeping out noxious insects during the kerning or swelling of the grain; whereas the lodicules or rudimentary petals are now apparently quite functionless; and so we may congratulate ourselves that they are there at all, to preserve for us the true ground-plan of the floral architecture in grasses. Indeed, they have not survived by any means in all grasses; among the smaller and more degraded kinds they are often wholly wanting, having been quite crushed out between the calyx and the grain. It is only the larger and more primitive types that still exhibit them in any great perfection. On the other hand, one group of very large exotic grasses, the bamboos, has three regular petals, thus clearly showing the descent of the family as a whole from rush-like ancestors, and also obviously suggesting that the obsolescence of the inner petal in the other grasses is due to their small size and their closely packed minute flowers.

Among the stamens, one-sidedness has not notably established itself, for in wind-fertilized plants they must necessarily hang out freely to the breeze, and therefore they do not get much crowded between the other parts. A few grasses still even retain their double row of stamens, having six to each floret; but most of them have only one whorl of three. In some of the lower and more degraded forms, however, even the stamens have lost their trinary order, and only two now survive. This is the case in our own very degenerate little sweet-vernal-grass, the plant which imparts its delicious fragrance to new-mown hay. But in the cereals and in most other large species the three stamens still remain in undiminished effectiveness to the present day.

Finally, we come to the most important part of all, the ovary. This part, alternating with the stamens, has the same arrangement of styles relatively to the axis as in the case of the petals; and it has undergone precisely the same sort of abortive distortion. The two outer styles, hanging freely out of the calyx, have been preserved like the two outer lodicules; but the inner one, pressed between the grain and the inner pale (with the stem behind it), has been simply crushed out of existence, like its neighbor the inner lodicule.

Thus the final result is that the whole inner portion of the flower (except as regards stamens) has been distorted or rendered abortive by close pressure against the stem (due to the crowding of the florets in the spiky form), while the whole outer portion remains normal and fully developed. We have an outer pale representing a single normal sepal, and an inner pale representing two dwarfed and united sepals; we have two normal outer lodicules or petals, and a blank where the inner petal ought to be; we have three stamens, symmetrically arranged, among the faithless faithful only found; and we have finally two normal outer styles, with a blank in place of the absent inner style. The accompanying diagram, compared with that already given, will make this perfectly clear.

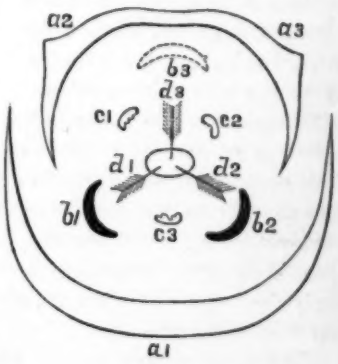

FIG. 2.

Here, a^1 represents the outer pale or normal sepal, while a^2 and a^3 represent the inner pale composed of the two united sepals. Again, b^1 and b^2 stand for the two lodicules or surviving petals, while b^3 marks the place of the lost petal, now found in the bamboos alone. The stamens are lettered c^1, c^2, and c^3. The two existing styles are shown by d^1 and d^2, while d^3 marks the abortive inner style, now not even present in a rudimentary condition. It will be observed at once that all the outer side is normal, and all the inner side more or less abortive through pressure against the axis.

Thus it will be seen that the line of links which connects the grasses and cereals with the lilies is absolutely unbroken, and that it consists throughout of one continuous course of degradation. At the same time, by this one-sided and spiky arrangement, the grasses secured for themselves an exceptional advantage in the struggle for existence. No other race of small, wind-fertilized plants could compete with them for the possession of the open, wind-swept plains; and over all these they spread far and wide, rapidly differentiating themselves into a vast number of divergent genera and species, each adaptively specialized for some peculiar habitat, soil, or climate. At the present time, the grasses number their kinds by thousands; they extend over the whole

world, from the poles to the equator; and they form the general sward or carpet of greenery over by far the larger portion of the terrestrial globe. Even in Britain alone, with our poor little insular flora, a mere fragment of that belonging to the petty European Continent, we number no less than forty-two genera of grasses, distributed into more than one hundred species. In fact, what may fairly be called degradation from one point of view may fairly be called adaptation from another. The organization of the grasses is certainly lower than that of the lilies, but it fits them better for that station of life to which it has pleased Nature to assign them.

The various kinds of grasses differ very little from one another in general plan; the flower in almost all is constructed strictly on the lines above mentioned; and the leaves in almost all are just the same soft, pensile blades, making them into the proper greensward for open, unwooded, wind-swept plains. But, like almost all other very dominant families, they have split up into an immense number of kinds, distinguished from one another by minute differences in the arrangement of the florets and the spikelets; and these kinds have again subdivided into more and more minutely different genera and species. One great group, with panicles of a loose character, and very degraded spikelets, has given origin to many southern grasses, from some of which the cultivated millets are derived. Another great group, with usually more spiky inflorescence, has given origin to most of our northern grasses, from some of which the common cereals are derived. This second group has again split up into several others, of which the important one for our present purpose is that of the *Hordeineæ*, or barley-worts. From one of the numerous genera into which the primitive *Hordeineæ* have once more split up, our cultivated barleys take their rise; from another, which here demands further attention, we get our cultivated wheats.

The nearest form to true wheat now found wild in the British Isles is the creeping couch-grass, a perennial closely agreeing in all essential particulars of structure with our cultivated annual wheats. But in the South European region we find in abundance a large series of common wild annual grasses, forming the genus *Ægilops* of technical botany, and exactly resembling true wheat in every point except the size of the grain. One species of this genus, *Ægilops ovata*, a small, hard, wiry annual, is now pretty generally recognized among botanists as the parent of our cultivated corn. There was a good reason, indeed, why primitive man, when he first began to select and rudely till a few seeds for his own use, should have specially affected the grass tribe. No other family of plants has seeds richer in starches and glutens, as indeed might naturally be expected from the extreme diminution in the number of seeds to each flower. On the other hand, the flowers on each plant are peculiarly numerous; so that we get the combined advantages of many seeds, and rich seeds, so seldom to be found else-

where, except among the pulse family. The experiments conducted by the Agricultural Society in their College Garden at Cirencester have also shown that careful selection will produce large and rich seeds from *Ægilops ovata*, considerably resembling true wheat, after only a few years' cultivation.

Primitive man, of course, did not proceed nearly so fast as that. Of the very earliest attempts at cultivation of *Ægilops*, all traces are now lost, but we can gather that its tillage must have continued in some unknown Western Asiatic region for some time before the neolithic period; for in that period we find a rude early form of wheat already considerably developed among the scanty relics of the Swiss lake-dwellings. The other cultivated plants by which it is there accompanied and the nature of the garden-weeds which had followed in its wake point back to Central or Western Asia as the land in which its tillage had first begun. From that region the Swiss lake-dwellers brought it with them to their new home among the Alpine valleys. It differed much already from the wild *Ægilops* in size and stature; but at the same time it was far from having attained the stately dimensions of our modern corn. The ears found in the lake-dwellings are shorter and narrower than our own; the spikelets stand out more horizontally, and the grains are hardly more than half the size of their modern descendants. The same thing is true in analogous ways with all the cultivated fruits or seeds of the stone age; they are invariably much smaller and poorer than their representatives in existing fields or gardens. From that time to this the process of selection and amelioration has been constant and unbroken, until in our own day the descendants of these little degraded lilies, readapted to new functions under a fresh *régime*, have come to cover almost all the cultivable plains in all civilized countries, and supply by far the largest part of man's food in Europe, Asia, America, and Australia.—*Macmillan's Magazine.*

A FEW WORDS ABOUT EATABLES.

By C. B. RADCLIFFE, M.D.

CLERICUS. I have had a good breakfast.

Medicus. So have I.

C. I should not say so. I have emptied the toast-rack, and helped myself to three or four slices of cold roast-beef; you have had some galantine* with brown bread and butter, and not much of them. But I suppose it is all right. I am going in for a hard day's boating; you

* Something like head-cheese, but made of white meat.

are proposing to spend the day at home in finishing the diagrams, or tables, which you are going to use to-morrow at the hospital in your lecture on eatables, and which are now very much in the way when I want to see the pictures on the walls, or to take a book from a book-case. What you have taken would not enable you to do my work.

M. I am not so sure of that. At all events I am quite sure of this —that you are not wise in eating so much lean meat, in picking out every scrap of fat, and in taking no butter.

C. I want muscular power, and I feed my muscles by eating lean meat, which is muscle. I am right, so far, I suppose?

M. The muscle must no doubt be fed to enable it to act, but you are not at liberty to suppose, as you do, that the amount of urea and other excrementitious nitrogenous matter in the urine supplies the measure of the waste of muscle in muscular action which has to be repaired by food. You must seek this measure, not in the amount of urea eliminated by the kidneys, but in the amount of carbonic acid exhaled in the process of respiration; and the facts with which you have to do go to show that, after all, this food you are taking may not be that which is most suited to your wants to-day. As is shown in one of the experiments in which Pettenkofer was assisted by Voit, and as you may see in one of the tables which hide the pictures and books here—thus, No. 1—the difference between a day of rest and a day of hard work, as regards the elimination of carbonic acid and urea, is marked not by an increase in the quantity of urea, but by an increase in the quantity of carbonic acid, the actual quantities being—

	Grammes of carbonic acid.	Grammes of urea.
On a day of rest	911·5	37·2
On a day of hard work	1,184·2	37·

On the day of hard work there is a very marked *increase* in the quantity of carbonic acid, and a trifling *decrease* in the quantity of urea. What do you say to this fact? Again: As is shown in one of the experiments of Lehmann, and as you may see in this table, No. 2, the amount of urea eliminated by the kidney is, in the main, proportionate to the amount of nitrogenous matter contained in the food; the result of feeding a dog

On a purely animal diet being	53·2	grammes.
On a mixed diet "	32·5	"
On a vegetable diet "	22·5	"
On a non-nitrogenous diet, consisting of fat or grape-sugar or starch	15·4	"

Once more: As is shown by Edward Smith in an experiment upon himself, and as you may see in this table, No. 3, the amount of carbonic acid given off every minute is in direct proportion to the amount of work done in the time, the actual amount being—

During sleep	4·99	grains.
When lying down and half asleep	5·91	"
When walking at the rate of two miles an hour	18·10	"
When walking at the rate of three miles an hour	25·83	"
When turning the tread-mill at the rate of 28·65 feet in a minute	43·97	"

Similar facts are supplied in numbers by these experimentalists, and also by Fick and Winceslaus, and Traube and Parkes, and Pavy, and other excellent observers in this country and abroad ; but these three, about the correctness of which there can be no doubt, are sufficient to show that the amount of urea in the urine does not supply the measure of this waste of muscular tissue in muscular action, which has to be repaired by lean meat and other nitrogenous food, and that the food you really want to repair this waste may be carbonaceous rather than nitrogenous—simple fuel, rather than plastic material.

C. I shall, I expect, be quite ready for my dinner when I come back. I may have taken more lean meat than I wanted to keep my muscles in trim ; I have not taken more than I seem to want. I have been breakfasting in this way for a long time, and I was never in better trim for a long pull than now. I may be eating too much, but you must allow that I am eating the best kind of food.

M. I do not say that you are not eating the best kind of food ; I only say that lean meat is not the only kind of nitrogenous food which will serve your purpose. It is impossible to distinguish between the albuminose or peptone into which fibrine is resolved in the process of digestion and the albuminose or peptone into which albumen, or caseine, or gluten, or legumin, is resolved in this process. It is apparently of little or no moment whether these various nitrogenous articles of food are derived from the world of animal life or from the world of vegetable life. You must allow that an herbivorous animal is not less vigorous than a carnivorous animal ; and certainly you would find it difficult to show that man, who can live and thrive under the most dissimilar circumstances upon almost any kind of food, is vigorous in proportion to the amount of meat he contrives to consume.

C. You can hardly wish to depreciate the nutritive value of lean meat.

M. Certainly not. All the nitrogenous substances, animal and vegetable, are resolvable into albuminose in the process of digestion, but not with the same facility in every case. Some of them are digested more easily by some persons than by others ; and, besides, there may be differences in the albuminose itself which are recognizable by chemical means. In your own case, lean meat may be more digestible than any other nitrogenous compound, and the albuminose into which it is converted may be more easily assimilated. In another case, eggs or cheese or macaroni may better suit the requirements of the person taking it. I do not venture to lay down a hard and fast rule for you

or any one in this matter; I only want you to understand distinctly that a person who can not get a full allowance of lean meat, or who does not choose to get it, is not necessarily ill fed for that reason, even though he have to do hard work with his muscles.

C. If a large amount of nitrogenous food is not wanted as food for muscle or other tissues—for plastic purposes, that is to say—how is the excess disposed of?

M. The part of the nitrogenous food which is not wanted for plastic purposes is, after digestion, resolved by the action of the liver into urea, and the other excrementitious products which are met with in the urine, and into a compound containing carbon, hydrogen, and oxygen, without any nitrogen, which compound *may* be the substance called amyloid substance or glycogen. This non-nitrogenous compound is destined to serve as fuel for the production of heat and other forms of force. The portion eliminated as urea, which is simply excrementitious, and the complemental portion, which is destined to serve as fuel, is as 33·20 to 66·80; and therefore it is easy to see that a large part of the nitrogenous food—but little less than two thirds, that is to say—may be devoted to other than plastic purposes, and that a little more than one third may be simply wasted. Moreover, the comparatively small portion of nitrogenous food which is actually wanted for plastic purposes is, there is reason to believe, eventually disposed of in the same way as the portion which is not used for plastic purposes, a little more than one third being wasted as urea, and a little more than two thirds being utilized as fuel. And if this be so, the question arises whether the fuel into which a large part of the nitrogenous form of food is resolved sooner or later is the best form of fuel for your purposes—whether, for example, you were wise in picking out the fat and in taking dry toast?

C. I leave you to find the answer to this question.

M. There is, I think, good reason to believe that much of the fuel without which life can not be maintained may be more easily supplied by non-nitrogenous substances than by nitrogenous substances. The fuel in nitrogenous food is not ready-made. This food has to be transformed, first of all, into albuminose or peptone, and then this albuminose or peptone has to be broken up, partly into the excermentitious portion which passes out of the system by way of the kidneys, and partly into the residual portion which is destined to act as fuel. An abundant supply of gastric and pancreatic and intestinal juices is wanted in order to bring about the proper formation of albuminose; without a healthy condition of liver and kidney it is evident that the albuminose may not be broken up (this breaking-up occurs chiefly in the liver) into urea and amyloid substance or glycogen, and that the urea (which passes out of the system by way of the kidneys) may not be eliminated. Moreover, it seems to be certain that no one can take a large amount of meat and other highly nitrogenous compounds for

a long time unless he also do a large amount of muscular work—unless he do much more work of this sort than the great majority of human beings are willing or able to do. Fat and butter and oily matter generally, on the other hand, require no digestion, in the proper sense of the word. They are converted into an emulsion—which is no more than a mechanical mixture like cream, by the action of the pancreatic and duodenal juices chiefly, and by the action of the bile partly, and this emulsion passes directly into the general circulation of the blood through the lacteals directly, without going the round of the portal circulation and the liver, as albuminose has to do. Fat and butter and oily matters generally are fuel ready-made, or which only need to be emulsified in order to be in this case ; and they have this advantage also—that they are burned up in the system, without leaving behind them, so to speak, any ash like urea. And, as force-producing agents—if the capacity for oxidization may be taken as a measure—the value of fat and oil is almost double that of fibrine or albumen.

C. I can see that I may have been taking too much lean meat and too little toast ; I can also see that I may have been especially wrong in avoiding fat and butter ; but I do not see how to set to work to reform my doings.

M. What you have to do, first of all, is to bear in mind that the daily loss which has to be made good by food, in a man of medium stature and in moderate work, amounts to 4,800 grains of carbon and 300 grains of nitrogen, and that, in round numbers, lean meat contains 11 per cent of carbon and 3 per cent of nitrogen, and bread 30 per cent of carbon and 1 per cent of nitrogen.

C. Is it so ?

M. Yes. The daily rate of wasting of the system which I have mentioned is that which is brought to light by very many observations, carried on by many persons in various ways, with a view to regulate the food-rations of soldiers and sailors and prisoners, and other ration-fed people ; and as to the proportion of carbon and nitrogen in lean meat and in bread the evidence is sufficiently conclusive.

C. Upon these data I can easily calculate how much meat and bread I really want if I choose to live wholly on meat or bread, and how the meat and bread ought to be apportioned if I take meat and bread together.

M. The calculation is ready made for you, and the result shows very plainly that you must mix your lean meat and bread in certain proportions if you care to feed without wasting good food. In order to replace the daily loss of 4,800 grains of carbon by lean meat, the quantity of meat you must take is 43,637 grains, or rather over 6 pounds—a quantity which contains 1,009 grains of nitrogen in excess of the 300 grains actually wanted. In order to replace the daily loss of 300 grains of nitrogen by bread, the quantity of bread you must take will be 30,000 grains, or about 4 pounds—a quantity which ex-

ceeds by 25,200 grains the 4,800 grains of carbon which are actually wanted.

C. My carnivorous tendencies, then, may not be so very extravagant, after all. I never ate 6 pounds of lean meat, or a third of that amount. I do not think I have suffered any sort of harm from the nitrogen which I may have taken in excess; I am sure I could never eat 4 pounds of bread, or half that amount, with impunity.

M. There is no occasion for you to eat these monstrous quantities of meat or bread. You must eat 6 pounds of lean meat every day if if you take nothing else but lean meat; you must eat 4 pounds of bread every day if you take nothing else but bread; but you may get on very well upon a comparatively small allowance of meat and bread if the two were combined in proper proportions. You want every day 4,800 grains of carbon and 300 grains of nitrogen; you find what you want, as Dr. Pavy shows, in 2 pounds of bread and in about ¾ pound of lean meat, thus:

	Carbon.	Nitrogen.
14,000 grains (2 pounds) of bread contain	4,200 grains.	140 grains.
6,500 " (about ¾ pound) of lean meat contain	605 "	165 "
Total	4,805 "	305 "

C. I quite shrink from the notion of having to take so much as 2 pounds of bread to make up for the daily waste of my body.

M. You need not take so much, or anything like so much, if you will take fat with your meat, or butter with your bread, or any oily matter in proper quantity. Fat is very rich in carbon, and so are all fatty and oily matters. You would have the 4,800 grains of carbon and the 300 grains of nitrogen which you want, if you took ¾ pound of lean meat and about 2½ ounces of fat. In proportion as you increase the amount of fatty or oily matter, you may diminish the amount of bread; and, within certain limits, which you may determine for yourself, you may probably please yourself as to the relative proportions of the two. Whether you would get on satisfactorily by excluding bread altogether, and taking fatty matter in its stead, is another question. The growing chick within the egg has plenty of oily matter to feed upon, and nothing of the nature of starch or sugar, or any other carbo-hydrate to take the place of bread. The sucking mammal finds a large amount of oily matter in the milk upon which it feeds, and a somewhat larger amount of lactine, or sugar of milk, which, as a carbo-hydrate, may more or less take the place of bread. In the hen's egg, the proportion of fatty matter to albuminous matter is as 82 grains to 110 grains. In cow's milk the proportion of fatty matter to lactine is as 351 grains to 468 grains, and of these two substances in conjunction, together with caseine, as 811 grains to 300 grains. In 2 pounds of bread and ¾ pound of lean meat the proportion of fatty matter to carbo-hydrates is as ·944 ounce to 16·320

ounces, and of both these substances together to nitrogenous matter as 17·264 ounces to 4·908 ounces. In point of fact, the proportions of nitrogenous matter, of fatty matter, of carbo-hydrates, and of mineral matter, in the dry constituents of a hen's egg, of a pint of cow's milk, and of 2 pounds of bread and ¾ pound of lean meat, according to Dr. Pavy, are :

1. In the dry constituents of the contents of a hen's egg :

Nitrogenous matter	110 grains.
Fatty matter	82 "
Mineral matter	11 "
Total	203 "

2. In the dry constituents of a pint of cow's milk :

Nitrogenous matter	369 grains.	·843 ounces.
Fatty matter	351 "	·802 "
Lactine	486 "	1·069 "
Mineral matter	72 "	·164 "
Total	1,260 "	2·878 "

3. In the dry constituents of 2 pounds of bread and ¾ pound of uncooked lean beef :

	Bread.	Beef.	Total.
Nitrogenous matter	2·592 ounces.	2·316 ounces.	4·908 ounces.
Fatty matter	·512 "	·432 "	·944 "
Carbo-hydrates	16·320 "	....	16·320 "
Mineral matter	·736 "	·612 "	1·348 "

C. By thus putting the composition of egg and milk side by side with that of bread and meat, the conclusion you would have me draw, I suppose, is, not only that fatty matter is present in large quantity in the two model forms of food, egg and milk, but also that fatty matter may be made to take the place of the starch and sugar of bread.

M. By comparing the composition of 2 pounds of bread and ¾ pound of lean meat with that of eggs, you may also, I think, form some idea of the amount of fatty or saccharine matter which is necessary to replace the 2 pounds of bread. The nitrogenous matter of 6 pints of milk or thereabout is equivalent to that of 2 pounds of bread and 3 pounds of lean meat, for in 6 pints of milk there are 4·082 ounces of fatty matter and 6·416 ounces of lactine ; and, therefore, you may conclude that the 4·082 ounces of fatty matter and 6·016 ounces of lactine which are present in the 6 pints of milk are equivalent, for practical purposes, to the ·944 ounce of fatty matter and to the 16·320 ounces of starch and other carbo-hydrates which are met with in the 2 pounds of bread and ¾ pound of lean meat. The nitrogenous matter of 20 eggs is about equal to that of 2 pounds of bread and ¾ pound of lean meat, for in 20 eggs there are 1,600 grains, or 3·66 ounces of fatty matter, and therefore you may conclude that the

1,600 grains, or 3·66 ounces of fatty matter which are present in the contents of 20 eggs may take the place of its ·944 ounce of fatty matter which are met with in the 2 pounds of bread and in the ¼ pound of lean meat, and of the 16·320 ounces of starch and the other carbo-hydrates which are present in the 2 pounds of bread. For it may be fairly assumed that the properties of the nitrogenous and non-nitrogenous compounds are as properly balanced in the egg and milk, which are the two great typical forms of natural food, as they are in the artificial combination of bread and meat of which we are speaking. You may draw your own conclusions from the tables on the walls in which these facts are set forth.

C. I also find in these tables a curious correspondence as to the amount of mineral matter in the three cases under consideration. The proportion of mineral matter in the other constituents is as 1 to 18 in the egg, as 1 to 17 in milk, and as 1 to 17 in the case of meat and bread.

M. This correspondence may not be quite so close as it seems to be. In the case of the egg an uncertain amount of lime, probably a large amount, ought to be added, for the shell becomes thinner and thinner as the process of incubation goes on, in consequence of the solvent action of the phosphoric acid which is generated by the oxidization of the phosphorus in the contents of the egg. In the case of white bread (white bread was used in this experiment) the greater part of the mineral matter, which is lodged chiefly in the husks of the grain, is sifted out in the preparation of the flour from which white bread is made. The earthy matter of the shell is certainly necessary to the proper development of the bones of the chick, and in all probability the bones are not the only tissues which are in this case. A dog lives long and thrives when it is fed upon brown bread, but not when it is fed upon white bread. Scurvy also is a speedy consequence of living upon salt meat, which differs from fresh meat chiefly in the fact that the salts belonging to it have been transferred to the brine. If the body is to be properly nourished, the mineral matters which are contained in the different articles of food can not be excluded, that is evident. And if these different articles of food are to be properly digested, the common salt, in the food or taken along with the food, may have a very important work to do in addition, for without it it is not easy to see how the gastric juice could acquire that part of its acidity which depends upon the presence of hydrochloric acid.

C. I have always avoided fat and butter, on the supposition that they would make me bilious and stout. I also thought that they were specially indigestible. I knew that they were of great value as heat-producers, as "elements of respiration," as fuel, and that the inhabitants of cold countries could not get on well without an abundant supply of them, but it never entered into my head to suppose that they might take the place of meat and bread.

M. You have only to consider how olive-oil is used in the warm parts of Europe where the olive is cultivated, and how ghee is used in India, in order to satisfy yourself that oily matter may be taken with facility in hot countries as well as in cold. You hear nothing about indigestion; you find that a bad olive-harvest or scant supply of ghee is a great national calamity. A Hindoo servant of a friend who kept up his Indian habits of eating here in London has often told me that in his own case nothing would make up for a deficiency of ghee or butter, and that his experience in this matter was the common experience of his countrymen at home or away from home. He looked upon a sip of ghee in very much the same light as that in which his fellow-servants looked upon a draught of beer. "Wine is good, but oil is better," said a peasant to the courier who was with me the other day in Andalusia, and after gulping down a large mouthful of olive-oil and smacking his lips more than once, the expression of his countenance was an apt illustration of the meaning of the Scriptural text which speaks of oil as making "the face to shine." Indeed, it may be taken for granted that oil may be used in large quantities throughout the year in the hot, olive-growing countries of the south of Europe, not only without making the people bilious or out of order in any way, but with unmistakable benefit.

C. You have spoken of fat and butter and cream as force-producing agents. You mean heat-producing, I suppose?

M. No; I meant what I said. They are heat-producing agents without doubt, but heat is only one of several modes of force which are closely correlated, and there is reason to believe that the molecular movement which gives rise to heat in one case may, in another case, give rise to electricity or some other form of physical force. I do not believe that heat is transformed into muscular force or nerve-force. I believe that the oxidization of the force-fuel, which gives rise to heat in one case, may in the case of a muscle and nerve give rise to the electricity which is peculiar to muscle and nerve; that this electricity antagonizes the state of action in both muscle and nerve; that in muscle it also causes elongation of the fibers during the state of rest, and that muscular contraction is brought about by the action of the attractive force which is inherent in the physical constituents of the muscular molecules when this force is no longer antagonized by their electricity. Indeed, all that I want to bring about muscular contraction is, not a metamorphosis of muscle which issues in the development of muscular force, nor a transformation of heat into muscular force, but simply a supply of electricity during the state of muscular inaction which will counteract the tendency which the muscle always has to contract as an elastic body. I want, indeed, not a special muscular force, but merely the common attractive force which is inherent in the physical constitution of the muscular molecules, and electricity to counteract the working of their attractive force when necessary.

C. I begin to see that I should have been in equally good trim for boating upon a very different kind of breakfast—that what I wanted was fuel for force-making rather than food for muscle-making; and now that I call to mind many facts which have been brought under my notice in countries where olive-oil is a staple article of food, I can, after what you have said about the connection of electricity with muscular action, understand how a man whose food is chiefly polenta or potato, with a little bread and oil, should have had as much muscular power at his disposal as ever I could contrive to compass. I once made the ascent of Etna with two Sicilian guides, who scarcely ever tasted any animal food except a morsel of fat bacon, and who lived chiefly on polenta and bread and olive-oil. More than once I thought I should never get to the top; they trudged upward with scarcely a sign of distress, though often having to expend a good deal of strength in pushing or pulling me up. And yet I was in what I thought to be an excellent "condition" at the time.

M. Yes.

C. It is, I suppose, right to believe that most of the weaklings who are benefited in this country by cod-liver oil, in Switzerland by neat's-foot oil, and in Russia by train-oil, would never have required these oils as medicine if their food had been sufficiently rich in fatty and oily articles. Cod-liver oil, I have heard you say again and again, has no special virtue of its own; it does good simply because it is oil. In my parish, where cod-liver oil is now used, suet diffused in milk, by boiling the two together, was used formerly, and, I am told, with equal benefit. In the cases where cod-liver oil is wanted the food in all probability has been lacking in fatty or oily matter. More force-fuel was wanted, I suppose.

M. I have a notion that the beneficial action of the fats and oils is not wholly to be accounted for by regarding them merely as force-producers. I believe that they actually serve as food for nerve-tissue. This tissue is in the main made up of a peculiar kind of fat, and I am convinced that nerve is starved if the food be wanting in a sufficient quantity of fatty or oily matter. I find that very many persons suffering from various chronic disorders of the nervous system have abstained from the fatty and oily articles of food, and that their state is almost invariably very much changed for the better when you can get them to take what they have avoided; I also find that a great number of delicate infants who can not take skimmed milk, and who do not take kindly to unskimmed milk, will take milk without any difficulty when it is enriched with cream. You may say if you will, "These facts only show that the fatty and oily matters have done good in these cases by acting as force-fuel," and I do not care to contradict you flatly. Indeed, all I can say is that I do not think I am illogical in supposing that they may do good also in serving as food for nerve-tissue.

C. I gather from what you have said that you would prefer, as food for invalids, milk enriched with cream or some other fatty matter, or the yolks of eggs, or something like the *bouillon* of the French *pot-au-feu*, to highly nitrogenous preparations from which the fat has been carefully skimmed off, such as Brand's essence, or Liebig's *extractum carnis*, or ordinary beef-tea.

M. That I certainly do; lean meat more or less fluidified and its juices are not the *sine qua non* in food if what I have said be true. On the contrary, I am disposed to think that in very many cases foods of this sort are really unsuitable, if only by calling upon the liver to do work which this organ is unequal to at the time.

C. You approve, then, of the old-fashioned milk diet rather than of the meat preparations which are now so much in vogue?

M. I am quite a believer in the virtue of unskimmed milk as a most suitable food for invalids of all ages in almost all cases; and I think that, in very many cases where this fluid does not agree, this difficulty will be got over by the addition of cream or some fatty matter. I can imagine that many mothers who can not feed their infants in the proper way, or get fresh cow's milk or cream, will have reason to be glad when they can procure preparations of condensed or inspissated milk enriched with various quantities of cream or some fatty matter. I can imagine that preparations more or less similar to those, which, for the reason I have just hinted at, might properly be called brain-food or nerve-food, might make cod-liver oil almost superfluous as medicine, and be of infinite service to countless myriads of persons in whom brain-power or nerve-power is lacking. I can imagine that in many cases it will be difficult to find a food for invalids which is to be preferred to lightly boiled yolk of egg, or to ordinary egg-flip. And in the cases where it is expedient to use flesh—meat in one form or another—I am sure it will be a great change for the better when, instead of having recourse to beef-tea, or Brand's essence, or Liebig's *extractum carnis*, the thoughts are turned to something like the *bouillon* of the French *pot-au-feu*, or rather to the very thing itself.

C. In what respect is this *bouillon* better than broth or stock?

M. It is much more pleasant to the taste. It is the outcome of ages of experience in the people who have a special genius for cookery. The animal and vegetable ingredients are so blended that the flavor of no one article is predominant. The *bouillon* contains all, or almost all, the soluble portions of those ingredients which are necessary for tissue-forming or plastic purposes, and for force-production, and, when taken along with bread, it provides a meal for an invalid which is most palatable, most digestible, and most restorative. It is the basis of all good gravies and soups, becoming, for example, excellent *purée* or pea-soup when a proper portion of pea-flour is added to it.

C. What about the *bouilli* which remains behind in the pot when

the *bouillon* is poured out? This can not be of much use if all, or almost all, the soluble matters have found their way into the *bouillon*. Is it much more than mere *padding?*

M. The *bouilli* can not be of any very great value as food; and I am very much disposed to think that its place may often be supplied with advantage by bread or potatoes, or some other form of farinaceous food. For myself, I should infinitely prefer a basin of *bouillon* with bread, or a basin of *purée* with bread, to a basin of *bouillon* and a plate of *bouilli* after it, without bread; and I think my instincts do not mislead me in this matter. I have a small appetite, and no superabundance of digestive power; my inclinations turn toward vegetable food rather than toward animal food, and I can easily see that farinaceous food may be really more suitable to the wants of my system than anything which is left behind in the *bouilli*.

C. I have for years been trying to make the poor in my parish acquainted with the virtues of the *bouillon* and *bouilli* of the French ordinary *pot-au-feu*,* but it never entered into my head to suppose that the *bouillon* was ever to be preferred to the *bouilli*, or that bread, or potatoes, or pea-flour, or polenta might now and then be substituted for the latter with advantage. I have also been a good deal inter-

* For making an ordinary *pot-au-feu*, Gouffé, in his "Livre de Cuisine" (Paris, Hachette, 1867), tells us to take of

Fresh meat	about	1½ lb.
Fresh bones (smashed)	"	½ "
Leeks	"	7 oz.
Carrots, Onions, Turnips	"	5½ "
Parsnips	"	1 "
Celery	"	½ "
Salt	"	1 "
Clove		1
Caramel		a very little.
Water		7 imperial pints.

Having placed the meat and bones in the stew-pan, with the bones undermost, the water is poured in, and the salt added. Then, after putting it upon the fire and allowing it to remain there until the water boils, and a scum collects upon the surface, the pan is removed from the fire and the scum skimmed off, a little cold water being first added for some purpose or other which is more intelligible to a cook than to me. Then this process of boiling, adding a little cold water, removing from the fire, and skimming, is repeated twice. Then, and not until then, the vegetables are added, and the pan is placed near enough to the fire to allow the contents to simmer (not to boil) for three or four hours. Then the *bouillon* is poured off and the *bouilli* prepared as a dish in one way or another. And lastly, when the *bouillon* is in the soup-tureen, and not until then, enough caramel is added to it to give it a delicate orange tinge—*une teinte dorée*. The lid of the stew-pan is never to be closed down tightly, for if this be done the *bouillon* is very likely to spoil by becoming thick and muddy.

The quantity given here is for four or five persons. To try and make less, Gouffé tells us, is bad economy, likely to issue in bad cookery, and this is intelligible enough, for the *bouillon* may be used in various ways, not only on the first day, but on the day following. The imperial pint, containing twenty ounces, is the pint referred to.

ested in an attempt which is being made by Messrs. Nelson, of Warwick, to introduce as cheap articles of food the inventions of our late friend Mr. J. R. Johnson, which are really properly made *bouillon*, and *purée*, and other soups in the form of dry chips. From a package of one of these preparations, which may be easily carried in a corner of the waistcoat-pocket, an excellent mess of *bouillon* or *potage* may be got in a few minutes with the help of a little water and fire, and I can easily see that the invalid and the working-man will both of them be great gainers in the matter of proper food, as well as in pocket, when this discovery is taken advantage of.

M. I, too, have been greatly interested in the articles to which you refer. I have tried the specimens which have been sent to me, and I highly approve of them. I think, indeed, that their introduction to the public marks a new epoch in the proper feeding of our countrymen, and that they will be made still more suitable for food when they are enriched to some extent by some form of fatty matter. I know how difficult it is to convince the poor of this country that all food is little more than *padding* except steaks, and chops, and cuts out of joints; and it will be long, I fear, before they can be persuaded to avail themselves of these preparations, or to learn to make for themselves the *pot-au-feu* of our neighbors across the Channel.

C. What else have you to say in the way of criticism about my unfortunate breakfast?

M. Only a word or two about bread and other farinaceous articles of food, and about the reason which made me prefer my gelatinous galantine of veal to your cold sirloin of beef. I think that bread may still be very properly spoken of as "the staff of life," and that other farinaceous articles of food may very properly be admitted into the same category with bread. The composition of wheaten-flour—which is more or less that of all flour prepared from cereal grain (oats, rye, barley, maize, rice, and the rest), and of leguminose seeds or pulse (peas, beans, lentils), and also of potatoes and some other tubers and roots—according to Dr. Letheby, is:

Nitrogenous matter	10·8
Fatty matter	2·0
Carbo-hydrates (starch, sugar, and the rest)	70·5
Mineral matter	1·7
Water	15·0

The nitrogenous matter consists of vegetable fibrine, albumen, and gluteine in the rough form of gluten. The fatty matter is in no way peculiar. The non-nitrogenous carbo-hydrates are starch, dextrine, sugar, gum, cellulose, and lignine—starch chiefly. The mineral articles comprise phosphates of lime and magnesia, salts of potash, and soda, and silica. Leguminose seeds or pulse contain as much as from twenty-five to thirty per cent of nitrogenous matter, mainly in a form

of caseine called legumine; rice and potato contain as little as about eight per cent of nitrogenous matter, and as much as eighty per cent of starch, the amount of nitrogenous matter and starch in these articles of food being in an inverse ratio to each other. Fatty matter is especially abundant in oats and maize. It is evident, therefore, that there is much in these vegetable articles of food which may take the place of the nitrogenous and oily articles which are supplied in animal food.

There is no essential difference as to chemical composition between vegetable albumen, and fibrine, and legumine, and oily matters, and animal albumen, and fibrine, and caseine, and oily matters; there is no perceptible difference in the albuminose or peptone into which the vegetable and animal nitrogenous substances are alike transformed in the process of digestion; there is no difference in the way in which the vegetable and animal oily matters are emulsified, and then taken up directly into the general circulation of the blood. Nor is it difficult to see how the starch, and sugar, and other non-nitrogenous materials which are peculiar to vegetable bodies are disposed of within the system. The way in which starch is disposed of in the stomach and bowels is not very well made out, and all that can be affirmed with certainty is that a great part of it finds its way into the liver through the portal system of vessels, and is detained there for a time in the form of amyloid substance or glycogen—a detention which is not altogether unaccountable, for, as Dr. Pavy points out, this substance "possesses diametrically opposite physical properties to sugar, being a colloid, and therefore non-diffusible, instead of a crystalloid and diffusible." There is no sufficient reason to suppose that the action of digestion, be that what it may, is always to transform the starch into sugar; for sugar in quantity could not be formed in the stomach and bowels without passing directly into the general circulation, and so out from the blood into the urine by way of the kidneys—without making, that is to say, the phenomena of diabetes a natural state of things instead of an unnatural. Nor is there sufficient reason for supposing that the amyloid substance of the liver is transformed into sugar, for this substance is as readily oxidizable and as fit for force-fuel as sugar. Nay, it may be questioned whether sugar itself is the force-fuel which the system is in need of. There is a very rapid generation of lactic acid in the stomach and bowels when sugar is taken as food, and it is not unintelligible that it should be so; for, with the help of a ferment of some sort, grape-sugar is readily converted into lactic acid. Indeed, all that has to be done is for one atom of anhydrous grape-sugar to split up into two atoms of lactic acid. Nor is it unintelligible that a certain part of the starch taken as food should pass, as it would seem to do, not into amyloid substance or glycogen, or into sugar, but first into dextrine, then into sugar, and then into lactic acid: for, as is seen in the list which I show you, there is a close

chemical correspondence between these various substances and those which are akin to them. Thus:

	Carbon.	Hydrogen.	Oxygen.
Starch, Dextrine, Cellulose, Lignine or woody matters, Gum	12	10	10
Cane-sugar	12	11	11
Grape-sugar, Amyloid substance	12	12	12
Lactic acid	6	6	6

There is no difficulty, therefore, in understanding, to some extent, how it is that, under the action of pepsin, or diastase, or some other ferment, starch, and dextrine, and cellulose, and lignine, and gum, and cane-sugar, and grape-sugar, and amyloid substance, may be transformed into the lactic acid which forms so important an ingredient in gastric juice, and that the lactic acid so formed, after having done its work in digesting nitrogenous substances, may be absorbed into the circulation directly, and be there disposed of in oxidization as a very readily inflammable fuel—perhaps as the more readily inflammable of all the force-fuels. And certainly there is no reason to believe that amyloid substance or sugar is more inflammable than lactic acid, but rather the contrary, for lactic acid can not be traced, as amyloid substance and sugar can be, beyond the limits of the alimentary canal. In any case I am, I think, at liberty to assume that a good deal of starch and sugar, and of the articles akin to them, are of great use in supplying lactic acid, and that this lactic acid has to do very important work, not only in the primary processes of digestion, but also as force-fuel.

C. If this be so, the effect of taking sour buttermilk, sour milk, and sour whey—the sourness of which depends upon the presence of lactic acid—ought to be unequivocally beneficial in many cases.

M. So it is. I have long been in the habit of recommending these articles in cases where the digestive power is feeble and the circulation wanting in vigor, and I am quite satisfied that the practice is very satisfactory in its results. Instead of being "a weight to the stomach," as fresh milk often is said to be in these cases, these drinks are generally found to facilitate digestion and to keep up the warmth of the system. Indeed, by using sour buttermilk and sour whey, I have often found it possible to leave off doses like rum-and-milk, and to do without alcoholic drinks altogether.

C. I am prepared to believe what you say by what I know of the experience of those who take sour milk or sour buttermilk habitually, or who have tried the whey-cure. I have more than once heard an Irish peasant say that he misses the sour milk he takes along with his potatoes almost as much as the potatoes themselves, and that "it

warms him like whisky and keeps off the rheumatiz." I have again and again felt myself benefited by taking buttermilk—by returning to what was a common practice in the district in which I spent my boyhood. And, certainly, I find it difficult to turn a deaf ear to all that I have heard in praise of the whey-cure in Switzerland and elsewhere by those who have tried it for dyspepsia and rheumatism.

M. I was led to recommend sour buttermilk or sour whey by reflecting on the very facts to which you refer.

C. What about the fattening effects of starch and sugar and other carbo-hydrates? Are these substances convertible into fat?

M. Possibly—nay, probably. At the same time I am disposed to think that in many cases the apparent transformation into fat is to be accounted for by the storing up in the system of the fatty and oily materials of the food—that these materials may remain behind by being, perhaps, less combustible than the lactic acid into which amylaceous and saccharine substances are naturally transformed.

C. You have still a word to say in justification of your preference for your gelatinous galantine.

M. The nitrogenous alimentary substances are divided into proteine compounds and non-proteine compounds. The former (the albuminous group) albumen, fibrine, caseine and their varieties, yield proteine when treated by heat and an alkali; the latter (the gelatinous group) containing gelatine and chondrine—gelatine prepared from bone and structures containing fibrous tissue, chondrine prepared from cartilage—does not yield proteine when so treated. Proteine is looked upon as the base or radical of the albuminous group; but it may only be an occasional chemical product. In any case it does not do to suppose that the non-proteine compounds forming the gelatinous group are useless as articles of food. The proteine and the non-proteine compounds are all reduced to albuminose in the process of digestion, and resolved afterward in the same way into urea and the residual force-producing compounds which in all probability is amyloid substance or glycogen. An animal soon dies if it be fed solely on gelatine; and so it does also if it be fed solely on albumen, or fibrine, or starch, or sugar, or oily matter. The different elements of food, animal or vegetable, must be mixed in certain proportions, which are not yet very clearly made out, before an omnivorous animal can thrive upon them. There may be no occasion to take gelatine as food, for gelatine and chondrine are certainly formed in the system from any kind of albuminose; there can not well be any harm in taking it, for, as I have said, it is transformed into albuminose like any other form of nitrogenous substance; and there may be great good in taking it, for the coatings of the cells and fibers of muscle and nerve are made up of a structure like elastic tissue, which yields gelatine in abundance. Indeed, the popular notion that there is something specially strengthening in jelly may not be altogether a fallacy. I can easily believe that

the gelatine may be wanted to provide for the proper nourishment of the coatings of the fibers and cells of nerve and muscle, and that a lack in this provision may bring about an abnormal disposition to involuntary action in nerve and muscle. I believe that these coatings are charged as the walls of a Leyden jar are charged during the state of rest, and that the degree of this charge and the indisposition to discharge is in proportion to the integrity of these coatings; in other words, I believe that the discharge which attends upon and produces this state of action, voluntary and involuntary, in nerve and muscle alike, is more likely to happen in the case where these coatings are insufficiently developed than in the case where they are sufficiently developed; and, so believing, you will easily understand why I think that gelatine may really be of high value as an article of food.—*The Practitioner.*

SKETCH OF SIR C. WYVILLE THOMSON.

THE name of Sir CHARLES WYVILLE THOMSON is inseparably associated with the first explorations of the depths of the ocean, and with having proved that abundant forms of animal life lived there where it had been believed that only a few scattering organisms were able to maintain an isolated and precarious existence. Professor Thomson was born at Bonsyde, Linlithgowshire, Scotland, March 5, 1830, and died on the 10th of March, 1882. His father was a surgeon in the service of the East India Company, and spent most of his life abroad. His grandfather was a distinguished clergyman of Edinburgh; and his great-grandfather was "Principal Clerke of Chancellary" in the time of the Rebellion of 1745. He went to school at Merchiston Castle Academy, which was then conducted by Mr. Charles Chalmers, a brother of the eminent Rev. Dr. Chalmers, after which he entered the medical course of the University of Edinburgh, in 1845. After three years of study here, he began to feel the effects of overwork, and, as a means of gaining a year's rest, we are told, he took the lectureship on botany in Queen's College, Aberdeen. In the following year he was appointed to lecture on the same subject in Marischal College and University. In 1853 he was chosen to the professorship of Natural History in the Queen's College, Cork, and a year after that to the chair of Mineralogy and Geology in the Queen's College, Belfast. He distinguished himself from the very beginning of his active career as an investigator among the lower forms of animal life. His first published paper appears to have been one on the application of photography to the compound microscope, which was read before the British Association in 1850. While at Aberdeen he published several papers on the Polyzoa and Sertularian Zoöphytes of Scotland,

and some speculations on the development of certain medusoid forms, which attracted notice and were considered too daring by Johnston and Edward Forbes. During this period, too, he entered upon those researches of the crinoids of past times and the crinoidal forms of modern times, of which he took *Comatula rosacea* as a typical specimen, which, with their direct and indirect results, led him up to the grand work of his life. A British pentacrinus had been discovered and described by Vaughn Thompson thirty years before, and determined by him to be but the young stage of the "rosy feather-star," but nothing more had been learned about it. Professor Thomson undertook to complete the investigation and fill out the life-history of the animal; and the account of his researches was given to the Royal Society in 1862 and published in the volume of the "Philosophical Transactions" for 1865. This investigation on the pentacrinoid stages of comatula was but a part of a series of observations on the genus *Pentacrinus* itself, and Professor Thomson collected a mass of material with the object of writing a memoir on the group.

Up to nearly this time, it had not been believed by scientific men that life did or could exist below a certain depth of the sea. Professor Forbes had admitted the existence of a zone of deep-sea coral extending from fifty fathoms below the surface to an unknown depth, a region in which, he held, "as we descend deeper and deeper, its inhabitants become more and more modified and fewer and fewer, indicating our approach toward an abyss where life is either extinguished or exhibits but a few sparks to mark its lingering presence." This skepticism, however, was becoming weaker under the testimony of living specimens that were from time to time brought up from undoubtedly great depths.

About 1864, Mr. G. O. Sars, of the Norway Fisheries Commission, dredged up a number of specimens of a strange crinoid from a depth of seven hundred feet, and, continuing to dredge, found an abundance of animal life at about the same depth. Professor Thomson was invited by Sars's father, the illustrious Professor Michael Sars, to visit Christiania and see the specimens. The two, after examining them, concluded that they were closely related to one of the fossil genera, allied to the family of the *Apiocrinidæ*. Here, then, they had a living representative of a group supposed to be extinct, and of a form which had lived over from the Cretaceous epoch.

In 1868 Dr. Carpenter, being engaged in investigations on a living crinoid from the West Indies, visited Professor Thomson to discuss the subject in which they were both interested; and on this occasion Thomson told his visitor that the one unexplored field awaiting the investigation of naturalists was the sea; that he was convinced that when explored it would yield immense treasures to science; and suggested to him to use his influence with the Admiralty to secure the grant of a vessel, suitably fitted up for deep-sea research. The use of

the surveying-ship Lightning was granted, and with it a cruise was made in the North Atlantic Ocean in August and September, 1878. Among the results of the expedition was the procuring of evidence that animal life was varied and abundant at depths of between six and seven hundred fathoms; that great masses of water at different temperatures were moving about, each in its particular course; and that many of the deep-sea forms of life were closely related to fossils of the Tertiary and Cretaceous periods.

In 1869 the surveying-ship Porcupine was lent for exploration, and made a survey of the west coast of Ireland, under the scientific direction of Mr. Gwyn Jeffries, and of the Bay of Biscay and the track of the Lightning's survey under Professor Thomson. The Porcupine was lent again in 1870, but Professor Thomson was prevented by ill-health from engaging in the surveys, and they were conducted to Gibraltar by Mr. Gwyn Jeffries, and in the Mediterranean by Dr. Carpenter. By the time the Porcupine's survey was completed, and under the promptings of the results obtained in the previous surveys, an extensive scientific interest in work of this kind was awakened. A representation was made to the Government by the council of the Royal Society, urging that an expedition be dispatched to investigate the great oceans and take an outline survey of their bottoms. The proposition received general support, and was acceded to by the Government, who granted the Challenger, a main-deck corvette of 2,306 tons, for the use of the expedition.

Captain G. S. Nares, R. N., was called from the survey of the Gulf of Suez to take charge of the vessel, and the second place in command was given to Commander J. P. Maclear, R. N., son of the late Astronomer Royal at the Cape of Good Hope. Professor Thomson was given the scientific direction of the expedition, and took as his associates Mr. J. J. Wild, of Zurich, private secretary; Mr. J. Y. Buchanan, of Edinburgh, chemist; and Mr. H. A. Moseley, Dr. von Willemoes Suhm, and Mr. John Murray, naturalists. The vessel was fitted up with all the appliances which the forethought of the naval experts and scientific men interested in the preparation for the expedition could devise for making the delicate and often complicated observations which were to be undertaken, some of which had hardly been attempted before on other than an experimental scale. The plans were prepared by the Admiralty in conjunction with a committee of the Royal Society, and reasonable liberty of variation from them, when circumstances might make it expedient, was allowed to the two chiefs. The personal composition of the expedition was changed during the voyage by the recall of Captain Nares, to take charge of an Arctic expedition, and by the death of Dr. Willemoes Suhm. Otherwise the plan was carried out essentially as arranged in the beginning. The special object of the expedition was to investigate the physical and biological condition of the great ocean-basins.

The Challenger left Sheerness December 17, 1872, and crossed the Atlantic four times, making a course of nearly twenty thousand miles during 1873; in 1874 she went southward from the Cape of Good Hope, spent nearly a month among the southern ice, dipping into the Antarctic Circle as far as she could with safety, then traversed the seas of Australia and New Zealand, made observations in the Malay Archipelago, and reached Hong-Kong in November, after making a course of more than seventeen thousand miles; in 1875 she traversed the Pacific, making a course of about twenty thousand miles, and in the early part of 1876 she crossed the Atlantic for the fifth time, to fill up blanks in her former observations, finally reaching England in May.

During this course of 68,890 miles, 362 stations were established, and observations and collections made at them. The magnitude of the collections is illustrated in a statement made by Professor Alexander Agassiz, that, "if a single individual, having the knowledge of eighteen or twenty of the specialists into whose hands they were to be placed, were to work them up, he would most certainly require from seventy to seventy-five years of hard work to bring out the results which the careful study of the different departments ought to yield." They were assigned to various gentlemen recognized as authorities in different departments for description group by group.

The most prominent and remarkable result of the voyage was the final establishment of the fact that the distribution of living beings has no depth-limit, but that animals of all the marine invertebrate classes, and probably others also, exist over the whole of the flora of the ocean. But, although life is thus universally extended, probably the number of species, as of individuals, diminishes after a certain depth is reached.

Professor Thomson had been led by his researches in the Lightning to the belief that the chief formation now going on in the bed of the Atlantic was a chalk, "*the* chalk of the Cretaceous period." This belief grew more firm with continued investigations, but was modified after the Challenger Expedition, when the species deposited were found to be in very few instances identical with those of the chalk, or even with those of the modern tertiaries. "But," he added, in his address on the subject before the British Association, in 1876, "although the species, as we usually regard species, are not identical, the general character of the assemblage of animals is much more nearly allied to the cretaceous than to any recent fauna."

Professor Thomson had been elected in 1870, previous to the dispatch of the Challenger Expedition, Professor of Natural History in the University of Edinburgh, succeeding Dr. Allman. He was only relieved from duties during the expedition, and held the professorship until October, 1881, when he resigned it upon a retiring allowance granted him by the Senatus. Immediately on Professor Thomson's

return, testimonials of appreciation of his services to science began to come in from various quarters. He had already been a Fellow of the Royal Society since 1869. He was now knighted in June, 1876; then he was awarded one of the gold medals of the Royal Society; was toasted by Professor Huxley at a scientific banquet given at Edinburgh in honor of the expedition; was created by the King of Sweden a knight of the Order of the Polar Star at Upsala, where he went with Professor Balfour, as a representative of the Edinburgh Senatus, to attend the tercentenary of the ancient university; was made LL. D. at Aberdeen, D. C. L. at Dublin, a Doctor of Philosophy at Jena, D. Sc. and Fellow of various British and foreign societies. In 1877 he was appointed to deliver the Rede Lecture at Cambridge. In 1878 he presided over the Geographical Section of the British Association, and took as the subject of his address, "The Advances which have been made in Late Years in the Application of the Physical Sciences to the Illustration of the General Condition of the Earth." He was also Vice-President of the Jury on Raw Products at the Paris Exhibition of 1867. He took the lead in organizing the School of Art in Belfast, under the Science and Art Department, and was the chairman of the first board of directors. He was a Conservative in politics, and was a magistrate and Commissioner of Supply for the county of Linlithgow.

His health, never very vigorous, was not improved during his voyage on the Challenger. In June of 1879 he was attacked with paralysis, and had to suspend the conduct of his classes in the university, and lay aside the work of superintending the compilation of the Challenger's researches. He was never able to work steadily afterward. He had a second attack about four months before his death, after which he seemed to be getting along through the winter tolerably well, till about two weeks before his death, when he got a severe chill from exposure, from which he never recovered.

Sir Wyville Thomson's principal literary works include "The Depths of the Sea," containing the accounts of the expeditions of the Lightning and the Porcupine, in which is given all that is known as to the records of the existence of deep-sea life up to 1865; the "Voyage of the Challenger. The Atlantic," in two volumes, giving a preliminary account of the general results of the Challenger Expedition; and his part of the work in the formal official report of the expedition, of which he lived to see only the first three volumes completed. At the time he was prostrated, he was preparing for the press a narrative of the voyage, to appear in the official work, based on one drawn up by Staff-Commander Tizard, the chief commanding officer of the Challenger. He also delivered several public addresses before scientific and popular bodies, which were marked by clearness of statement and sustained interest. The departments of zoölogy to which he devoted most attention were those which included the corals, cri-

noids, and sponges, and upon these his opinion was regarded as of great weight. He was, says "Nature," speaking of his residence at Belfast, "something besides an enthusiastic biologist. . . . By interesting himself not only in what concerned the college, but even in the welfare of the town in which it was located, he soon gathered around him a host of intelligent and warm-hearted friends. In social life, it was but an accident that would reveal the biologist, and one witnessed only the general culture and the artistic taste of a well-bred man."

His associate in the Challenger Expedition, Mr. Moseley, has given, in a notice in the "Academy," a graphic sketch of his personality as it manifested itself during the observations on board the vessel. "His enthusiasm," says Mr. Moseley, "with regard to everything connected with the dredging, sounding, and various physical and chemical operations carried on in the deep sea during the cruise, knew no bounds. He spent hours on deck watching them, and waiting for the dredge to come up, and though, as time wore on, the interest of the seamen and naval officers in the arrival of the dredge or trawl at the surface failed, and that even of the remainder of the scientific staff flagged, he was never known to be absent at the moment it appeared at the ship's side, whatever the weather, but was to be seen peering down into the water, eagerly attempting to diagnose the contents of the net when it was still dipping in and out of the sea-surface as the ship rolled to and fro. When once it was on board, he would eagerly grope for treasures, squeezing each cephalopod between his fingers, always with a lurking hope to find a belemnite's bone in it, or expecting at last to grasp a trilobite. These never came, but there was an abundance of other wonders."

Concluding his sketch, Mr. Moseley says: "Sir Wyville was an excellent lecturer, a most genial companion, and an excellent host. He was fond of amusements of all kinds, and was never happier than when he went on shore from the Challenger in some out-of-the-way island, with his gun on his shoulder, in pursuit of birds-of-paradise, or other treasures."

A fund of five hundred guineas has been raised by subscription for erecting a memorial to Sir Wyville Thomson; with respect to which it has been decided that a bust by Mr. J. T. Hutchinson, R. S. A., shall be placed in the University Hall, Edinburgh, and that what is left of the fund shall be devoted to putting a stained-glass window in the church of St. Michael at Linlithgow.

EDITOR'S TABLE.

LAW AGAINST RIGHT.

WHATEVER truth there may be in the declaration that "paper constitutions will not work as they are intended to work," it is very certain that written and unwritten constitutions do not work in the same way, and do affect the habits of mind of the people very differently. In England "the Constitution" is a body of precedents and practices, which are interpreted and applied to new cases in accordance with the historic spirit of the Government; while in this country "the Constitution" is a printed document that may be bought for a nickel, and learned by heart in a week. To find out the meaning and obligations of the English Constitution, we are referred to the principles of the national policy; to find out the requirements of our own Constitution, we are referred to its explicit clauses. These Constitutions do not work alike; and in one important respect they do not work as we should anticipate. We should naturally expect that the English Constitution would be so complex a thing as to be far removed from the people, and create a multitude of law interpreters, who would practically have the whole subject in their own hands. And at first sight it would seem that with a written constitution so much is gained in the way of simplicity, where everything is made as plain, definite, and positive as language can make it, that the people should perfectly understand the instrument, and there would be little need of professional commentators. But, in point of fact, the English Constitution is by no means withdrawn from the consideration of the English people, nor does the simplicity of our own written charter save us from the need of a host of lawyers. Yet there is a divergence in the function of the lawyers in the two cases, which corresponds to an equal diversity in the mental habits of the people in the respective countries. Where the supreme law is unwritten, and has to be sought in the usages and principles of the government, the process of its interpretation is far more open than in the other case, more a matter of adaptation and readjustment. Tendencies and progress and new circumstances are taken into account, and each step of the elucidation becomes a part of the continuous national process of establishing the Constitution. The people know the fundamental principles, the great landmarks of guidance, which are to control the course of lawyers and judges, and they can understand whether the supreme objects of the Constitution are fulfilled or defeated. Appeal will naturally be made to the more rational and liberal elements of the national policy, and the task of amending and improving the Constitution itself will be felt as a permanent responsibility. The men of to-day are, therefore, as much "founders of the Constitution" as those of former generations.

But it is very different where the Constitution is a written document which was made the supreme law in a former age. Only the glorified "fathers" are here ranked as founders of the Constitution. It embodied the ideas and the wisdom of its time; but all questions are closed by it, save those of the verbal significance of its clauses. It is amendable only through political spasms, and by an implied impeachment of the patriots who formed it, and whom there is an increasing tendency to regard as infallible. Questions of interpretation necessarily arising, tend to become narrow and technical, a matter of rules and definitions, while the lawyers will

naturally become expert in all the arts and artifices of word-manipulation. Under such a system the letter of the law will tend to take the place of the spirit and purpose of the law. In these circumstances there will arise the habit, both on the part of lawyers and of citizens, of reverencing the forms of law more than the principles which lie behind them. The purposes by which all legislation should be animated and determined will come to be habitually overlooked. Questions of right and justice will be ruled out as irrelevant, the highest and only solicitude being as to the binding phraseology of specific clauses. In this way the whole apparatus of justice may be perverted to the work of stifling the national conscience, and the real purposes of government defeated by its own agencies. There are various exemplifications of this, to which it may be well to call attention.

The London "Economist," when some time ago discussing the privateering question with reference to England, Russia, and America, recognized the point here made, by stating that the United States may be expected to fulfill its treaty stipulations, but that it will do so from a lawyer's point of view as to their meaning and obligation. It says: "The Government of the United States is not a dishonest Government, or even a tricky Government, widely as that impression is diffused. Owing to circumstances upon which it is unnecessary here to enter, it is a Government very much in the hands of lawyers, and of lawyers trained to encounter one another by means of the quibbles, devices, and 'sharp' interpretations of law which a generation ago were so much in vogue among ourselves. Such men are very apt to read contracts strictly, to seek loop-holes when clauses in those contracts are inconvenient, and to suggest interpretations which give them an apparent advantage, and this practice undoubtedly annoys foreign diplomatists, who do their little trickeries in a different and, as they think, a more gentlemanly way. But the same training inspires in the American party-leaders a great respect for law itself, and especially for written law, great acuteness in interpreting it, and a great reluctance to see it neglected, and they are no more likely to break or evade unmistakable rules than English judges are."

The treatment of the slave question in England and the United States well illustrates the diverse working of their constitutions. It was by a recognition of the predominance of the spirit of the English Constitution that Chief-Justice Holt was led, early in the eighteenth century, to decide that "as soon as a negro slave comes into England he is free." This decision, after being long resisted, was reaffirmed by Lord Mansfield in 1772 in the celebrated case of Somerset. These decisions settled the principle that the English Constitution was adverse to slavery. But of that celebrated jurist and eminent legal reformer, Lord Mansfield, it has been remarked that "his eagerness to discourage technicalities and his preference of the principles of civil law occasionally led him to make the law instead of expounding it." This, however, is the American view of the American biographer who forgot the constitution-making function of the English judge. Both Holt and Mansfield, in their great decisions, simply fell back upon the principles of natural justice, which they assumed it to be the supreme object of the English Constitution to secure; and, it being established forever that "a slave can not breathe in England," the policy of hostility to slavery became national, and was carried out in the gradual and pacific emancipation of all slaves in the British dependencies. The struggle was long and the progress slow, but the result was a triumph of the principles of right over the selfishness and greed that were legally embodied in the slave system.

It was far otherwise in this country. Slavery created by law was unquestionably recognized and protected by the American Constitution. Yet there were provisions in the instrument which, if liberally and humanely interpreted, would have destroyed it. The Constitution, however, was construed literally, verbally, and technically, and no question was permitted to be raised in regard to the principles of justice which should underlie all such charters, and which were profusely declared in its preamble to pervade the American Constitution. The written Constitution thus, in fact, became the bulwark of slavery, and was accordingly denounced by the passionate reformers as "a league with death and a covenant with hell." To go behind the literal constitutional provisions for the protection of slavery was denounced as virtual treason. The question of abstract right and wrong was held to be irrelevant and impertinent; the slave system was legal, and therefore not to be meddled with. Henry Clay laid down the American formula upon the subject in the Senate of the United States in 1838, in the following words: "What the law declares to be property *is* property." This was the lawyer's view, and it was also the people's view; and it was this triumph of law over right that maintained slavery until, American civilization proving unequal to the contest, it was ended at last by the barbarism of war.

Equally marked has been the contrast of the English and American policies on the question of the rights of authors to property in their works. We have referred to this before, but our people can not be reminded of it too often. The question is one of no little perplexity, but very easily befogged, and it is well fitted to test statesmanship and national character.

It had been long felt in England that arrangements upon the subject of copyright, both national and international, were imperfect, and there was a growing demand for their amendment. The government understood its duty in the matter, and a few years ago a parliamentary commission was appointed to sift the whole subject, to report upon the deficiency of existing legislation, and what practical measures of improvement are demanded. The commission was ably constituted, and made a deliberate and exhaustive investigation, summoning before it the weightiest men both at home and abroad, and patiently taking their testimony, whatever its bearing or import. The report recognized the question as one of national importance, and as involving grave state obligations. There was no quibbling or paltering about the rights of authors. The sophistries of crotchety witnesses were brushed aside, and it was broadly affirmed as a matter of radical justice that when a man produces a book by his labor he has a right to property in it which the government is imperatively bound to protect. The subject, moreover, was lifted out of the sordid sphere of mere political expediency, which dominates so widely in international intercourse. The temptation was sore to reduce it to the trading basis of reciprocity, but this temptation was firmly resisted. It was felt that, whether America will grant copyright or not, the course of England is clear. In the report made by the commissioners in 1878, they say: "It has been suggested to us that this country would be justified in taking steps of a retaliatory character, with a view of enforcing, incidentally, that protection from the United States which we accord to them. This might be done by withdrawing from the Americans the privilege of copyright on first publication in this country. We have, however, come to the conclusion that it is advisable that our law should be based on correct principles, irrespective of the opinions or policy of other nations. We admit the pro-

priety of protecting copyright, and it appears to us that the principle of copyright, if admitted, is one of universal application. We, therefore, recommend that this country should pursue the policy of recognizing the author's rights, irrespective of nationality."

Very different was the treatment of this question under similar circumstances by the American Government. Its attitude in regard to the rights of authorship has long been the scandal of the civilized world, and efforts from time to time have been made to induce a change in the national policy. A committee of the United States Senate was appointed in 1873 to consider the subject, and report what action it is desirable to take. The proceeding that followed was nothing less than disgraceful, evincing, as it did, a contemptuous indifference toward the whole subject. Not the slightest interest was expressed in it, either as a question of private right or public honor. While the English report opened the whole inquiry on broad moral grounds, the American report sharply closed it to all considerations of equity, justice, and right. While the hand of the lawyer was hardly discernible in the English document, no other hand was visible in ours. Instead of a valuable and instructive statement befitting the magnitude and seriousness of the question, the American report was but a shabby tract of half a dozen pages, arguing as usual that the Constitution is in the way of any change of existing practices. In the discussion before the committee, arguments on the right and wrong of the question were objected to by the senatorial chairman as irrelevant, and under his ruling the debate shrank into a mere pettifogging wrangle over constitutional clauses, and a ventilation of the most ridiculous projects, which were held in the report to show that the American people are not agreed upon the subject. The committee declared that they saw nothing wrong which it is desirable to correct, and recommend Congress to take no action in the matter. It was but another exemplification of the way legal and constitutional forms are used in this country for the protection of palpable wrongs. Instead of asking first what is right, and then demanding that the law shall be made to conform to it, the people, like the lawyers, ask first what is the law, and then hold that this determines the right.

"PIRATICAL PUBLISHERS," OR A PIRATICAL GOVERNMENT.

We print a brief discussion of the copyright question, by Mr. Leonard Scott, under the title of "Piratical Publishers," which, whatever its demerits, has at least the merit of being thoroughly American. Although discussing the question how a given act should be morally characterized, his standard of judgment is but the dictum of American law.

It is not easy to defend a right and its opposite wrong by the same argument, as the reasons which favor the one destroy the other. Hence, in most discussions upon the subject, it will be found that those who oppose international copyright do it upon grounds that are equally subversive of domestic copyright. All arguments which put the public advantages of cheap literature above the rights of authors to property in their books, tell just as effectually against the American as the English author, and logically require the immediate destruction of American copyright laws. If the taking of Professor Tyndall's book from him without payment, that the American public may have it cheaply, is no crime, neither would the taking of Professor Silliman's book, for the same purpose, be a crime. Mr. Scott reasons that, although a right might be conceded in a Utopian state of society, where one universal government should legislate for the equal advantage of all, yet, as this is not the

case, and dishonesty is the common policy, the right of the individual may be properly denied. But what is the limit to this principle? How does existing dishonesty make an excuse for still further dishonesty? If, because the nations are governed by selfishness, we may take an Englishman's literary property without paying him for it, is there not sufficient rascality, jobbery, fraud, corruption, plunder, and general selfishness in the operation of the American Government to justify the consistent fleecing of an American author also? Again, Mr. Scott maintains that because we send experts abroad to collect information about manufacturing processes, institutions, etc., and do not pay for it, therefore he sees no "*moral wrong*" in taking larger amounts of information in the shape of books without paying for them. But do not Western capitalists send on their experts to the East to pick up information for Western use in the construction and operation of manufacturing establishments for which appropriated knowledge they never think of paying? Would there, therefore, be no moral wrong in taking an American author's book on manufactures without compensation? If the logic is good for anything, it cuts up all copyright, root and branch.

Mr. Scott furthermore says, "The whole system of laying duties upon foreign merchandise is one of pure selfishness, and as much a robbery or piracy of the natural rights of the foreigner as anything yet done by an American republisher." But because we shackle our trade, and thus injure the foreign manufacturer, certainly affords no good reason for robbing a foreign author of his property.

But Mr. Scott is most eminently American in the following statement: "The withholding of an international copyright law does not take away from them [foreign authors] what they never possessed or had any right to claim. The American republisher, therefore, in the absence of such a law, buys the English book at the English price, and thinks that he has done all that is required of him to become its absolute owner, to do with it whatever the laws of his country do not forbid. Who shall say that among these rights is not the right to reprint it?"

Must we not conclude that this paragraph betrays some perversion of the moral sense? The author who creates the book by his labor, and makes it valuable property, is denied even the poor "right to claim" the ownership of that property; while the publisher, who simply buys a single copy, becomes its "absolute owner," with "the right to reprint it" and to go on multiplying it as long as he can make money out of its market value. This is pretty rank doctrine, and we do not see how those who hold it need have much squeamishness about the terms in which it is characterized. Yet Mr. Scott's article is a protest against the calling of American republishers pirates, as he alleges is done by their foreign "calumniators."

Now, there are two questions here: (1.) Is the term "piracy" properly applicable to any form of republication in this country? And (2), if so, who is chargeable with it? The taking by one person of another person's property without consent or payment is held as a crime, is called stealing, and he who takes it is known as a thief. If such appropriation is accompanied by violence, it is commonly called robbery. If the property has that peculiar form which is termed literary, and is appropriated by indirection, as where the embodiment of it is indefinitely copied, the taking of it, without permission and without remuneration, has in it the peculiar meanness which has led to its being metaphorically branded as "piracy." It is the flagrant wrong of the transaction that is marked by the term of reprobation, and those are pirates who are guilty of perpetrating it.

Where American republishers negotiate with the foreign owners of books, and pay them for the liberty of reprinting, there is of course no piracy, and there has been an increasing tendency in recent years on the part of American republishers to recognize the foreign author's ownership of his book, and to pay him for it. But, while this practice has been growing on the part of reputable publishers, so as to have become a rule with many of them, another class has come into the field who scout all notions of authors' rights, and reprint everything they can get hold of and make a profit on. These are not shop-lifters, or burglars, or highway-robbers, or horse-thieves, but they are book-thieves: they steal literary property by pirating the works which they have not paid for and which do not belong to them.

But an objection will be raised here—an American objection—and, if an American dictionary is consulted, it will be found that piracy is defined as an "infringement of the law of copyright by publishing the writings of other men without permission." Therefore, it will be said, American republishers break no law, and are, therefore, not pirates. The escape is but technical; the moral quality of the transaction remains, and only where the moral sense has been bedeviled, so that men are insensible to the intrinsic nature of the act, will any such pretext be urged. The foreign author has a copyright by law, and we recognize that copyright by law is in itself a righteous thing. If he can not extend the law as far as his books are demanded, it is no fault of his; he has done everything in his power to protect his own rights. His books are stolen by our publishers, and they quibble that they are not pirates because there is no American law against such literary theft. But this changes nothing in the essential nature of the transaction; it only shifts the responsibility. If our thieving publishers are not piratical, it is because the Government gives them a technical relief from the charge by itself assuming the odium. If the publishers sneak behind their Government to shelter themselves from an opprobrium, then the opprobrium must be fastened upon the Government. The wrong is committed in its most deliberate and aggravated form, and if we have not "Piratical Publishers" then we have a piratical Government. There is no blinking the scandalous fact; and the responsibility of it must rest somewhere. When a whole class of men are engaged in open, systematic, and extensive stealing—appropriation to themselves, without payment or consent, of property not their own—if the state abets them in the practice by refusing to forbid it, the state is entitled to all the execration demanded by the crime. The attitude of the American Government on this question is a reflection upon the national character in the eyes of the civilized world. We may meet this with brazen-faced assurance, and twaddle about the dissemination of cheap information among the people, but we can not divorce cause from effect in the political any more than in the physical world, and the consequences of perpetuating a great national injustice will tell with infallible certainty in the degeneration and degradation of the national character.

LITERARY NOTICES.

FACTS AND PHASES OF ANIMAL LIFE, interspersed with Amusing and Original Anecdotes. By VERNON S. MORWOOD, Lecturer to the Royal Society for the Prevention of Cruelty to Animals. New York: D. Appleton & Co. Pp. 286. With Engravings. Price, $1.50.

THE author has endeavored to describe, especially for the young, in simple language, the marvelous organization, the instinct, memory, sagacity, and inventive faculties of some of the more common animals and insects. He has also made a prominent presentation of the fidelity, love, affection,

and other pleasing characteristics which all animals exhibit, more or less, one to another, in order to cultivate in his readers a higher regard for all animals, and to lessen the aversion with which some animals are contemplated. The whole is varied and illustrated with numerous anecdotes. The usefulness of animals and the services they render to man are discussed in a more general manner, and the considerations which should induce a kindly treatment of them are presented in the final chapters. The subject-matter of the work, its arrangement, even to the chapter-titles, the method of treatment, the anecdotes, the style, and the author's genial manner, are all adapted to excite and hold interest, and make the book an excellent one to put into the hands of children.

SWIFT. By LESLIE STEPHEN. Harper & Brothers. 1882.

THIS is an interesting example of the influence of modern knowledge upon our estimate of character. Swift's life, as presented by his earlier biographers, has left the impression that he was so unlike the rest of the world that he could not be judged by ordinary rules; that the traits of his character were inharmonious and inexplicable. He has been set down as a sort of human monster, as made up of the rarest genius, the most unusual kindness, and the most abominable cruelty. But, when we rise from the perusal of this little volume, we find that our abhorrence has been changed to tender sympathy for the misfortunes of this extraordinary man.

Mr. Stephen does not think that Swift was a blameless man. In considering his conduct toward the women he loved, when he can no further unravel the threads of the story and consistently explain events, he closes with this sensible and kindly remark: "It is one of the cases in which, if the actors be our contemporaries, we hold that outsiders are incompetent to form a judgment, as none but the principals can really know the facts."

As an example of Stephen's mode of treatment, take the following. After giving an account of the poverty endured by Swift in his youth, the author remarks: "The misery of dependence was burned into his soul. To secure independence became his most cherished wish; and the first condition of independence was a rigid practice of economy. We shall see hereafter how deeply this principle became rooted in his mind; here I need only notice that it is the lesson which poverty teaches to none but men of strong character." This trait is again referred to in connection with Swift's behavior to Stella and Vanessa. He says: "Swift had very obvious motives for not marrying. In the first place, he became almost a monomaniac upon the question of money. His hatred of wasting a penny unnecessarily, began at Trinity College and is prominent in all his letters and journals. It colored even his politics, for a conviction that the nation was hopelessly ruined is one of his strongest prejudices. He kept accounts down to half-pence and rejoices at every saving of a shilling.

"The passion was not the vulgar desire for wealth of the ordinary miser. It sprang from the conviction stored up in all his aspirations that money meant independence. Like all Swift's prejudices, this became a fixed idea which was always gathering strength. He did not love money for its own sake. He was even magnificent in his generosity. He scorned to receive money for his writings; he abandoned the profit to his printers in compensation for the risks they ran, or gave it to his friends. His charity was splendid, relatively to his means. In later years he lived on a third of his income, gave away a third, and saved the remaining third for his posthumous charity, and posthumous charity, which involves present saving, is charity of the most unquestionable kind. His principle was that, by reducing his expenditure to the lowest possible point, he secured his independence, and could then make a generous use of the remainder. Until he received his deanery, however, he could only make both ends meet. Marriage would, therefore, have meant poverty, probably dependence, and the complete sacrifice of his ambition. If, under these circumstances, Swift had become engaged to Stella, he would have been doing what was regularly done by fellows of colleges under the old system. There is, however, no trace of such an engagement. It would be in keeping with Swift's character if we

should suppose he shrank from the bondage of an engagement."

Egotism and love of dominion were also dominant traits of his character, which, along with his love of independence, his almost diseased sensitiveness, and his life-long ill health, enable his biographer to give, in most cases, a consistent view of his life. But, when psychology breaks down, medical science steps in and completes the rational account of this hitherto mysterious man.

Readers of the "Monthly" will remember an article by Dr. Bucknill, in the April number of last year, giving an account of "Dean Swift's disease." We were there told of Ménière's recent discovery of a definite form of disease—labyrinthine vertigo, which is shown by conclusive evidence to have been the "cruel illness" to which Swift so often alludes in his journal and correspondence. From the age of twenty he suffered from this disease, whose characteristic symptoms are, that the patient is suddenly seized with vertigo and a feeling of nausea or positive sickness, with great constitutional depression and faintness.

"This fact," says Stephen, "requires to be remembered in every estimate of Swift's character. His life was passed under a Damocles's sword. . . . The references to his sufferings are frequent in all his writings. It tormented him for days, weeks, and months." Dr. Bucknill says that it was not necessarily connected with the brain-disease which ultimately came upon him, but it accounts for the terrible anxiety always in the background, and for much in Swift's gloomy despondency.

We commend the book, as well for its intrinsic charm, as because it dispels a most painful feeling in regard to one of the greatest of men.

HERBERT SPENCER ON AMERICAN NERVOUSNESS: A SCIENTIFIC COINCIDENCE. By GEORGE M. BEARD, A. M., M. D. New York: G. P. Putnam's Sons. Pp. 17. Price, 50 cents.

THE late Dr. Beard, as is well known, has for some years made a professional study of nervous diseases, and has published a book, which was duly noticed in these pages, entitled "American Nervousness." As was natural, writing and publishing much upon the subject, he came to regard himself as a representative man who had made the field very much his own; and, as was equally natural, he grew somewhat sensitive in regard to the recognition of his claims.

The present pamphlet has its origin in this state of feeling. It is put forth as a reclamation of ideas which he regards as belonging to himself, and which have been used, he thinks, without due recognition of this fact. He is of the opinion that Mr. Herbert Spencer was to a very notable extent indebted to him, consciously or unconsciously, for the distinctive ideas of his speech at the late complimentary dinner in New York. Dr. Beard does not accuse Spencer of plagiarism; indeed, he repeatedly disclaims the accusation. Yet he declares that there is a "coincidence," both of thought and language, between what he had published and Mr. Spencer's expressions, that is so remarkable as to justify calling public attention to it by printing the respective statements in parallel columns. There is here, if not an insinuation of plagiarism, at least an oblique imputation of literary indebtedness not acknowledged.

Dr. Beard is at the pains to say that his action in this matter is not entirely of his own motion; he has been influenced in it by others. He remarks: "I have not been the first or only person to notice this parallelism; it has been the subject of independent comment by various individuals. The frequency of these comments led me to make the following detailed comparison." Dr. Beard was here mislad, both by his own bias and the bad judgment of his friends. There is nothing even remarkable in the similarity of passages quoted, letting alone all questionable implications—nothing more than that vague "coincidence" which is constantly arising when two thinkers happen to be running upon the same track. Dr. Beard puts his most pointed illustration first. He quotes Mr. Spencer as saying: "We have had somewhat too much of the gospel of work. It is time to preach the gospel of relaxation." He then quotes from "American Nervousness," p. 313, his own expression, "The gospel of work must make way for the gospel of rest," and this he offers as a remarkable "coincidence."

But certainly no word is more stereo-

typed in universal usage than the term "gospel," as applied to views or doctrines which a party is engaged in propagating, from the gospels of the evangelists to Carlyle's "Gospel of Dirt," and the "gospel of dig" now discussed in the educational journals. The "coincidence" in the application of this word we should hold to be of a very innocent sort.

And here all coincidence ceases. The two gospels are not of the same kind. The two phrases "gospel of rest" and "gospel of relaxation" do not mean the same thing. Instead of being alike, their meanings are rather contrasted. We have simple passivity on the one hand, and activity of a given kind on the other. The "gospel of rest" is obeyed by inaction, by stopping work, or going to bed; while the "gospel of relaxation" implies rather a change of activity from work to play, and it connotes recreation, entertainment, and amusement. The "gospel of relaxation" means the substitution of agreeable diversion for tiresome labor. The Puritanical Sunday would answer to Dr. Beard's "gospel of rest," but it would not answer to Herbert Spencer's "gospel of relaxation." Dr. Beard's requirement was made into a gospel of duty by the ancient Jews; Mr. Spencer's requirement has as yet been made into a gospel of duty nowhere. The cases are, therefore, conspicuous for their lack of "coincidence," and the same thing will be observed in all the other counts.

The burden of Dr. Beard's pamphlet, as we have intimated, is to show that he was first in the field in the systematic treatment of "American nervousness"; and, as he entitles his pamphlet "Herbert Spencer on American Nervousness," the impression is sought to be conveyed that Mr. Spencer has recently entered upon a definite field of inquiry which Dr. Beard had made his own long ago. But in the first place the views of the two men are far from being of the same character, and, in the next place, Spencer's views are much older than those of Dr. Beard. As regards priority, it is only necessary to say that we heard Mr. Spencer give expression to the main ideas of his address long before the name of Dr. Beard was ever publicly heard of. It was an early outcome of his evolution studies, that, as in social progress the fighting dispensation of society gave way to the working dispensation, so the working dispensation must in turn give way and become subordinate to the higher objects to which work and wealth are tributary. The stage beyond, to which he maintains we are tending, will be characterized by a more perfect organization of the means of human enjoyment. That life is for pleasure in its largest sense is a cardinal idea of the Spencerian philosophy, and that the social fulfillment of this supreme end must come in practical forms, by giving larger and more systematic play to our pleasure-loving impulses and varied capacities of enjoyment, is an explicit and leading inculcation of Mr. Spencer's works. That completer living is to be attained by a multiplication of pleasurable satisfactions, and the perfected art of enjoyment was taught; for example, in his "Education," written twenty-five years ago, and the doctrine is at the basis of the "Data of Ethics," the most advanced treatise of his philosophical system. Mr. Spencer took up this cherished and long-familiar topic, in his New York address, simply because he was freshly and forcibly reminded of its importance by what he saw in this country.

HISTORY OF THE PACIFIC STATES OF NORTH AMERICA. Central America, Vol. I, 1501–1530. By HUBERT HOWE BANCROFT. San Francisco: A. L. Bancroft & Co. Pp. 704. Price, cloth, $4.50.

THIS volume, the sixth in the great series of historical works by Mr. Bancroft, gives the history of the southernmost section of North America which borders on the Pacific, during the period of discovery and colonization previous to 1530. The first chapter, of a hundred and fifty pages, is introductory; half of it being devoted to "Spain and Civilization at the Beginning of the Sixteenth Century," and the rest to a "Summary of Geographical Knowledge and Discovery from the Earliest Records to the Year 1540." The summary includes a series of voyages by the Northmen to the northeastern shores of America, extending over five centuries; and mentions many expeditions both eastward and westward by travelers from Southern Europe, the earliest of these being made in 1096. The value of this account is increased by copies of fif-

teen maps drawn by the geographers of this period. In the second chapter, the continuous narrative of exploration and conquest begins with the first voyage of Columbus.

The author shows that the princes and navigators of this period had plenty of faults. The sovereigns of Spain joined to their zeal in increasing geographical knowledge, and in extending the domain of the holy Roman Church, a lively solicitude for their own power and revenue. The author finds, both from his study of Spanish authorities and from the admissions of Prescott, that Queen Isabella has been far too highly lauded by both Prescott and Irving. Even Columbus, who generally gets so much pity for the ungrateful treatment he received, is shown to have had weaknesses and faults which brought many of his misfortunes upon him.

The American natives do not suffer much from a comparison with their white conquerors. If they sometimes showed a thirst for Spanish blood, it was because the means employed to make them good Catholics and citizens were, to say the least, no gentler than those in use in the Old World. "They were more children than wild beasts. . . . . Seldom was the Indian treacherous until he had been deceived."

Mr. Bancroft has consulted many books and manuscripts in preparing this work, and the list of authorities quoted, which occupies forty-eight octavo pages, together with the references in the foot-notes on special topics, give the volume great bibliographical value. The numerous foot-notes give interesting details in regard to ships, trading, methods of administration, of dividing land, and of locating towns. The volume is well supplied with maps, and the chronicle is enlivened by many amusing and illustrative anecdotes.

STATEMENT OF WORK DONE AT THE HARVARD COLLEGE OBSERVATORY, 1877–1882. By EDWARD C. PICKERING, Director of the Observatory. Cambridge, Massachusetts: John Wilson & Son. Pp. 23.

THE observatory has enjoyed for four years the revenue derived from an annual subscription of five thousand dollars. The last installments of the subscription expire in the present month, and an effort is now making to replace it with a permanent endowment of one hundred thousand dollars. The director calls attention to the fact that the increased amount of work made possible by the increased income is quite out of proportion to the augmentation of funds, because the expenses are largely the same in either case, and the increase is, therefore, directly available for scientific results. Fifteen assistants are attached to the observatory, and, by the division of labor rendered possible by so large a force, each man may be assigned the kind of work to which he is peculiarly adapted. In this way researches can be carried out in a few years which are beyond the reach of observatories where the corps of assistants is small.

PROCEEDINGS OF THE AMERICAN SOCIETY OF MICROSCOPISTS. Fifth Annual Meeting. D. S. Kellicot, Secretary, Buffalo, New York. Pp. 292, with Plates.

THE meeting of the society was held at Elmira, New York, August 15th to 17th last, under the presidency of George E. Blackham, F. R. M. S. The record contains a considerable number of papers of interest to specialists and students of microscopy, many of them well illustrated, of which two or three relating to organisms in Lake Erie and the water-supply of Buffalo and a memoir of Charles A. Spencer, the eminent maker of microscopes, deserve especial notice and are of more general interest.

CONTRIBUTIONS TO THE ANATOMY OF BIRDS. By R. W. SHUFELDT, M. D., United States Army. Washington, D. C. Pp. 210, including Twenty-four Plates.

THIS monograph is also embodied in the twelfth annual report of Professor Hayden's "Geological and Geographical Survey of the Territories," from which it is extracted. It contains descriptions, abundantly illustrated, of the osteology of the *Speotyto*, or burrowing owl; the *Eremophila Alpestris*, or horned lark; the *Tetraonidæ*, or grouse family; the *Lanius*, or Shrike; and the *Cathartidæ*, or buzzards.

POEMS. By MINOT J. SAVAGE. Boston: George H. Ellis.

MR. SAVAGE sings his unpinioned thought and free religion as well as preaches it. Not that he has made a hymn-book for his Bos-

ton society, or can not pretermit, if need be, the professional function. Quite the contrary. There are many quiet poems in this collection pervaded by genuine humor, or with fine touches of feeling for nature and human life, which show that the author writes from the inspiration of true poetic art. But the poems that most interest us are those marked by the strong poetic expression of ideas and emotions with which the author's mind is "possessed." The poems entitled "Where is God?" "The Age's Unrest," "Infidelity," "Galileo," "Vanini," "Magellan," "Darwin," "Kepler," and many other pieces, although making up but a small part of the book, would well justify the title, "Songs of Modern Thought."

THE GOSPEL OF THE STARS, OR PRIMEVAL ASTRONOMY. By JOSEPH A. SEISS, D. D., author of "A Miracle in Stone," "Voices from Babylon," "The Last Times," "Lectures on the Apocalypse," "Holy Types," etc. Philadelphia: E. Claxton & Co. Pp. 450. Price, $1.50.

THIS is an instructive book—instructive not because of the value of its information, but because it is an excellent representation of a certain phase of mind peculiar to these times, which springs out of the conflict of great adverse systems of thought. In the struggle of religion and science, which has been long developing, and is precipitated upon this age with much intensity, the fundamental question is, Which order of ideas—theological or scientific—shall predominate, and which take the subordinate place? It is now universally held that all truth is one. But, in the palpable issues that arise, unity can only be secured by some latitude of interpretation on one side or the other. Though all truth is one, the systems of belief are two, and there has got to be a yielding somewhere before the alleged unity can become a real unity. Men of science start with nature as it exists around them, and is open to exploration and the demonstration of its truths. And, when any system of thought is offered for acceptance, the men of science insist that it must be brought into conformity by interpretation with the order of truth established by science. Religious teachers, on the other hand—most of them, at least—start from theology, hold its doctrines to be in the ascendant, and demand that nature shall be interpreted in conformity with them as a subordinate system.

The work of Dr. Seiss is a thorough-going example of the dominance of theological ideas over scientific ideas. He, too, is engaged in the laudable work of reconciliation, but, like Hood's butcher, who "conciliated" his sheep by main force, our author reconciles science to theology by no little violence of interpretation. Its lesser details he knocks about without ceremony, and its larger conceptions he waves aside as illusions of not the slightest moment. Evolution, he declares, "*is a lie*," and, as this sufficiently illustrates, scientific truth has no weight with him. Steeped through and through with theological ideas, he can see nothing in the universe but his own system of divinity, while science is only useful as furnishing material to be twisted into conformity with theology, as he understands it. His book is pervaded with Scripture, and, both from the titles of the works he has formerly written and from the whole quality of this, it is seen that his mind is drawn to the mystical, the obscure, the enigmatic, cabalistic, and transcendental.

The special object of the present work is to show that "the true explanation of the origin and meaning of the constellations of the heavens, their figures and their names, as they have come down to us from the earliest ages of the human race," are only to be found in connection with Christian theology. It is commonly supposed that those fanciful celestial groupings of the stars into resemblances of animals, men, and other objects were devices of primitive times, before astronomical science had arisen. Herschel characterizes "those uncouth figures and outlines of men and monsters usually scribbled over celestial globes and maps" as "puerile and absurd." Dr. Seiss declares all this to be mere "rationalist conjecture," and solemnly maintains, on the other hand, that the constellations are pious intimations, illustrations, and witnesses of the scheme of salvation. The breadth of his view of the Christian system in the present year of grace is indicated by the following passage: "The gospel is chiefly made up of the story of the serpent

and the cross—the doctrine of the fall and depravity of man through the subtlety of 'the dragon, that old serpent called the Devil and Satan, which deceiveth the whole world,' and the recovery of fallen man through a still mightier One, who comes from heaven, assumes human nature, and, by suffering, death, and exaltation to the right hand of supreme dominion, vanquishes the dragon, and becomes the author of eternal salvation. The preaching of this is the preaching of *the gospel*."

But the rubbishy erudition that seems necessary to understand this gospel, according to the present commentator, is something frightful. Certainly, if such a performance as this can pass muster, and the "Pastor of the Church of the Holy Communion, Philadelphia," has a rightful place in the Episcopal Church, Heber Newton has no business in the organization.

MORAL EDUCATION, ITS LAWS AND METHODS. By JOSEPH RODES BUCHANAN, M. D. New York: S. W. Green's Son, 74 & 76 Beekman Street. Pp. 395. Price, $1.50.

ALTHOUGH this work, by its title, is limited to one phase of the great subject of education, and although the moral idea prevails throughout the exposition, yet the book is far from being a mere homiletic essay in the ordinary sense. The moral conception is dealt with in connection with many practical questions, so that there is a good deal of generality in the instructiveness of the treatise. Indeed, it is chiefly valuable from the breadth of the author's preparation for dealing with radical educational questions. Dr. Buchanan is an unfettered thinker, and his work is stamped with the individuality of his studies. He is, first of all, a physiologist—a student of man as a corporeal being, and he assigns to the subject of organization that fundamental place which it must hold in every rational system of culture, and which is beginning to be more clearly recognized in our own times than ever before. Yet the work is by no means and in no sense a physiological one, and the author is far enough from being a materialist. The truths of organic science are assumed rather than expounded, and on its basis and under its limitations the author deals with a whole range of the higher educational problems. No person interested in education can read the book without being helped by its information and its suggestions. It contains much of the philosophy of life, and many special problems that are now beginning to press upon teachers and educational managers are discussed with acuteness, ability, and much freedom from the restraints of tradition. It is impossible to enter here into any of the particular inquiries opened by Dr. Buchanan, and we have to confine ourselves to a general estimate of the character of the book. But, while very cordially commending it, the reader will not infer our agreement with all its views. We are all in that inquiring stage in regard to education which implies incompleteness of knowledge and a resulting diversity of opinion. We are working, it is to be hoped, toward a higher agreement, and such contributions as this of Dr. Buchanan are unquestionably valuable as means to this important end.

FIFTEENTH ANNUAL REPORT OF THE TRUSTEES OF THE PEABODY MUSEUM OF AMERICAN ARCHÆOLOGY AND ETHNOLOGY. Cambridge, Massachusetts. Printed by order of the Trustees. F. W. Putnam, Curator. Pp. 103.

THE trustees of the museum, in an appeal to the public last year, called attention to the fact that it is the only institution in the country especially for the preservation of collections and the study of American archæology, and that its income (the interest of $90,000) is only $4,500 a year. Its rooms, reasonably commodious and containing larger or smaller collections from different parts of the world—several hundred thousand specimens in all—are open free to visitors during business hours, and are supplemented with free descriptive lectures by the curator. The additions during the year include a valuable series of objects from the Ainos of Yesso (Japan), by Professor Penhallow; more than two thousand stone implements from Delaware, by Mr. H. R. Bennet; new objects, by Dr. C. C. Abbott, from his own collections in New Jersey, and exchanges from Ohio, Kentucky, and England; new specimens of the Wakefield (Massachusetts) stone implements in every stage of manufacture; potteries from Southeastern Missouri and Southern New Mexico, by

Mrs. S. B. Schlesinger; M. Bandelier's collections from the Pueblos and from Cholula, and Mr. Fred A. Ober's collection of copper implements from Oajaca, Mexico; specimens from English caves, and casts, by Mr. Dawkins; articles illustrating the making of pottery by the Caribs of British Guiana, from Professor H. A. Ward; soapstone pots from Northern Italy, by Dr. Emil Schmidt; and a cast of the "Endicott Rock" of New Hampshire. The curator carried on field-work at Madisonville, Ohio, and Indian Hill, Kentucky. More was done to make the museum and its objects known to the public, and more use was made of its collections for instruction and research, than in any previous year.

LECTURES ON ART. Delivered in Support of the Society for the Protection of Ancient Buildings. London: Macmillan & Co. Pp. 232.

THE six lectures are by five authors, each of whom has devoted particular attention to the study of the subject he presents. The lecturers and their subjects are—Reginald Stuart Poole, on "The Egyptian Tomb and the Future State"; Professor W. B. Richmond, on "Monumental Painting"; Edward J. Poynter, R. A., on "Ancient Decorative Art"; J. T. Micklethwaite, on "English Parish Churches"; and William Morris, on "The History of Pattern Designing," and "The Lesser Arts of Life." The lectures are, one and all, interesting and instructive.

THE FACTORS OF CIVILIZATION, REAL AND ASSUMED: Considered in their Relation to Vice, Misery, Happiness, Unhappiness, and Progress. Vol. II. Atlanta, Georgia: James P. Harrison & Co. Pp. 359.

THE whole work is to be in three volumes, of which the second precedes the first in time of publication. It treats of the subjects of more immediate and practical importance than those to be discussed in the first volume. The author maintains that man naturally inclines to goodness, and that all vice and misery arise from the operation of theological causes, bad government, ignorance, and poverty; or that the structure of society is defective because of defective institutions. Man, he holds, has a vital impulse to do implanted within him, which only requires that the institutions of society shall permit of its development, to create a growth "as grand in results as the magnificent oak bears in comparison to the insignificant acorn." The political economical factors of civilization are considered in this volume under the heads of "The Unhappiness arising from Poverty" and "The Unhappiness arising from Uncongenial Pursuits and Labor." The theological, governmental, and educational factors will be considered in the first volume; and the third volume will be devoted to "The Analysis of Happiness."

AMERICAN HERO-MYTHS. A Study in the Native Religions of the Western Continent. By DANIEL G. BRINTON, M. D. Philadelphia: H. C. Watts & Co. Pp. 251. Price, $1.75.

THIS volume is an endeavor to present in a critically correct light some of the fundamental conceptions which are found in the native beliefs of the tribes of America. The author does not consider it creditable that so little has been done in this field, and is disposed to be severe, but hardly too much so, on those who have had opportunities to investigate the subject, and have not used them. He rejects the idea that the native myths are distorted historical reminiscences and exaggerated statements respecting persons that ever really existed, and has been guided by the principle that "when the same, and that a very extraordinary, story is told by several tribes wholly apart in language and location, then the probabilities are enormous that it is not a legend, but a myth, and must be explained as such." The myths of the lower races, he believes, "express, in image and incident, the opinions of these races on the mightiest topics of human thought, on the origin and destiny of man, his motives for duty, and his grounds for hope, and the source, history, and fate of all external nature. Certainly, the sincere expressions on these subjects of even humble members of the human race deserve our most respectful heed." With these views and in this spirit, Dr. Brinton presents the results of his studies, from the most authentic, accessible sources, of the hero-gods of the Algonquins, the Iroquois, the Aztec tribes, the Mayas, and the Quichas.

REPORT ON THE CHARACTER OF SIX HUNDRED TORNADOES. By Sergeant J. P. FINLEY, Signal Corps, U. S. A. Washington: Office of Chief Signal Officer. Pp. 19, with Three Charts.

THE increasing frequency with which notices of tornadoes appear, as the list approaches the present time, is to be taken as a sign, not of more tornadoes, but of better observations. The season in which tornadoes appear most frequent is summer, and the month June. Spring is the next most frequent season, then autumn, then winter. The region most often visited includes the States of Iowa, Missouri, Kansas, and Nebraska, of which Kansas suffers the most. Outside of this region New York has the most tornadoes, and next, Georgia. Suggestions are given for avoiding the violence of tornadoes; many other lessons are derived from the study, and further ones are anticipated from further studies.

THE December (or Christmas) number of "Wide Awake" is a noble magazine of 136 pages, with a supplement of 60 pages, filled with articles of high literary character and unexceptionable tendency. It is adorned with a profusion of illustrations, which, though executed in the best style of the present fashion in wood-engraving, can not be considered equal to the illustrations in the same magazine ten years ago, when a purer taste and a better style prevailed.

PUBLICATIONS RECEIVED.

**** *Authors and others, sending papers and monographs for notice, will please specify, for general information, where they can be procured.*

Dime Question-Books: General History, Astronomy, Mythology, Rhetoric, and Composition, Botany, with Notes, Queries, etc. Albert P. Southwick. Syracuse, New York: C. W. Bardeen. Pp. 36 to 40 each. 10 cents.

Iowa Weather-Service Annual for 1883. Gustavus Hinrichs. Central Station, Iowa City. Pp. 40.

Should American Colleges be open to Women as well as to Men? Frederick A. P. Barnard, President of Columbia College, New York City. Pp. 17.

Massachusetts Institute of Technology. Eighteenth Annual Catalogue, etc. Francis A. Walker, Ph. D., LL. D., President. Pp. 102.

The Taxation of the Elevated Railroads in the City of New York. Roger Foster. New York: G. P. Putnam's Sons. Pp. 61.

Apparent Attractions and Repulsions of Small Floating Bodies. John Le Conte. Berkeley, California. Pp. 10.

Medicine and Medicine-Men. Anniversary Address. John Godfrey. New Orleans, Louisiana. Pp. 17.

"The Sociologist: A Monthly Journal." Vol. I, Nos. 1 and 2. Adair Creek, Knox County, Tennessee: A. Chavannes & Co.

On the Loess and Associated Deposits of Des Moines. W. J. McGee, Farley, and R. Ellsworth Call, Des Moines, Iowa. Pp. 24.

Circulars of the Department of Education: High-Schools for Girls in Sweden, pp. 6; Instruction in Moral and Civil Government, pp. 4; National Pedagogic Congress of Spain, pp. 4; Natural Science in Secondary Schools, pp. 9; The University of Bonn, pp. 67; Proceedings of Department of Superintendence of the National Educational Association, 1882, pp. 112. Washington: Government Printing-Office.

The Naval Use of the Dynamo-Machine and Electric Light. Lieutenant J. B. Murdock, U. S. N. Annapolis, Maryland. Pp. 385.

"Census Forestry Bulletin," No. 23—Estimate of the Consumption of Forest Products as Fuel during the Census Year. P. 1, with Map.

Department of Agriculture—Report of the Entomologist, 1882. C. V. Riley. Washington: Government Printing-Office. Pp. 104, with Plates.

The Condition of Niagara Falls, and the Measures needed to preserve them. J. B. Harrison. (Author's address, Franklin Falls, New Hampshire.) Pp. 62.

"The Reconstructionist: Devoted to the Substitution of Good for Evil." Samuel T. Fowler. Quarterly. Philadelphia: George A. Fowler & Co. Pp. 64. 25 cents.

A Method of Teaching the Greek Language Tabulated. John W. Sanborn, Batavia, New York. Published by the author. Pp. 44. 30 cents.

Statistical Report of Imports, Exports, Immigration, and Navigation, for the Three Months ended September 30, 1882. Washington: Government Printing-Office. Pp. 157.

Hospital Accommodations of County Poor-Houses. Dr. Charles S. Hoyt, Secretary. New York State Board of Charities. Albany, New York. Pp. 53.

Bromide of Ethyl (as an Anæsthetic). Julien J. Chisholm, M. D. Baltimore, Maryland. Pp. 8.

Report of an Exploration of Parts of Wyoming, Idaho, and Montana, in August and September, 1882, made by Lieutenant-General Sheridan. Washington: Government Printing-Office. Pp. 69.

"Journal of Social Science." December, 1882. A. Williams & Co., Boston, and G. P. Putnam's Sons, New York. Pp. 178. $1.

Report of the Standing Committee, New York State Board of Charities, on County Poor-Houses. Pp. 8.

On the Geological Effects of a Varying Rotation of the Earth. Professor J. E. Todd. Pp. 12.

"Scientific Proceedings of the Ohio Mechanics' Institute." Quarterly. December, 1882. Cincinnati, Ohio. Publishing Committee, Ohio Mechanics' Institute. Pp. 48. $1 a year.

The Place of Original Research in College Education. J. H. Wright, Dartmouth College, Hanover, New Hampshire. Pp. 29.

Mutual Relations of Intellectual and Moral Culture. Joseph Le Conte. Berkeley, California. Pp. 7.

General Weather-Service, United States. "Monthly Weather Review," November, 1882. Washington, D. C.: Office of the Chief Signal-Officer. Pp. 21, with Maps.

Papers of California Academy of Sciences on "Footprints found at the Carson State-Prison" (H. W. Harkness, M. D., Joseph Le Conte, C. D. Gibbs); on "Fossil Jaw of a Mammoth" (C. D. Gibbs); and on "Fresh-water Mussels" (Robert E. C. Stearns). San Francisco, California. Pp. 58, with Plates.

Science Ladders: Lowest Forms of Water Animals. N. D'Anvers. New York: G. P. Putnam's Sons. Pp. 59. 50 cents.

First Year Manual and Text-Book of Arithmetic. James H. House. Syracuse, New York: C. W. Bardeen. Pp. 156. 50 cents.

A Practical Arithmetic. G. A. Wentworth and Rev. Thomas Hill, D. D., LL. D. Boston: Ginn, Heath & Co. Pp. 351.

Notes on Ingersoll. Rev. L. A. Lambert. Buffalo, New York: Buffalo Catholic Publication Company. Pp. 184. 50 cents.

Herbert Spencer on American Nervousness. George M. Beard, M. D. New York: G. P. Putnam's Sons. Pp. 17. 50 cents.

Political Economy. Francis A. Walker. New York: Henry Holt & Co. Pp. 490. $2.25.

Introduction to the Study of Organic Chemistry. Adolph Pinner. Translated and revised by Peter T. Austen. New York: John Wiley & Sons. Pp. 403. $2.55.

Catalogue and Index of the Publications of the Smithsonian Institution. William J. Rhees, Washington, D. C. Smithsonian Institution. Pp. 328.

Slight Ailments: Their Nature and Treatment. Lionel S. Beale. Philadelphia: P. Blakiston, Son & Co. Pp. 283. $1.25.

The Cause of Variation. M. M. Curtis. Marshall, Minnesota: Published by the author. Pp. 115.

Report of the Chief Signal-Officer, War Department, 1880, pp. 1,120, with 119 Charts. The same, 1881, pp. 1,296, with 59 Charts. Washington: Government Printing-Office.

POPULAR MISCELLANY.

Experimental Demonstration of Ohm's Law.—An interesting experimental demonstration of the truth of Ohm's law was recently given by Professor Alfred M. Mayer, of the Stevens Institute of Technology, before the New York Electrical Society. This law, as is well known, affirms that in any electrical circuit the current flowing varies directly as the electro-motive force and inversely as the resistance, or, in symbols, $C=\frac{E}{R}$, where C is the current, E the electro-motive force, and R the resistance of the entire circuit, including that of the generator. To demonstrate the truth of this law, it is only necessary to show that, the resistance remaining constant, the current increases in the same ratio as the electro-motive force when this is augmented; or that, the electro-motive force being maintained constant, the current varies in the same ratio as the resistance as this latter is raised. In Professor Mayer's experiments the current was measured by means of a Thompson reflecting galvanometer—a delicate instrument in which the deflections of the needle are multiplied to any desired extent by means of a beam of light, reflected from a small mirror attached to the needle, which is received upon a screen. The novel feature of Professor Mayer's demonstration consisted in his mode of obtaining the current so that the electro-motive force could be known with great accuracy, and readily varied. This consisted in generating it by means of the movement of a coil of wire along a bar-magnet. The electro-motive force of the current so produced depends upon the number of lines of magnetic force cut by the moving coil in a unit of time, so that this can be varied by varying the speed with which a given coil is moved, or, the speed remaining the same, by varying the number of coils. Professor Mayer resorted to the latter measure, his apparatus consisting simply of an upright bar-magnet over the end of which a loop of wire could be slipped, the distance which this could slide being limited by a stop. The movable coils consisted of the same lengths of copper wire, in which there were taken one, two, or more loops, the resistance of each of these pieces being the same, so as to maintain that of the complete circuit constant. The coils were placed over the upper end of the magnet, and carried down until they rested upon the stop, the needle of the galvanometer brought to the zero of the scale, and then the coil pulled off the magnet with a quick motion. The deflection of the needle indicated a variation in the current in proportion to the number of loops of wire used, and when the resistance was varied in proportion to the amount of this variation. A better form of the apparatus is one in which the coil, instead of being moved by hand, is drawn up quickly by a spring, when it is released by the pulling of a trigger. With this, Professor Mayer is at present studying the development of magnetism in electro-magnets.

More about the Lignified Snake.—Doubts are expressed, in a paper recently read by Professor C. V. Riley before the Biological Society of Washington, as to the so-called "lignified serpent" of Matto Grosso, Brazil, which was described and illustrated in the November number of the "Monthly," being really a serpent at all; Professor Riley rather believes the forma-

tion to be the burrow of the larva of some beetle, filled up with excrement and rudimentary fiber, as such burrows commonly are filled. In support of his view he makes the points: that the object in advance of the so-called reptile's head to the unimaginative eye appears, not like an insect larva, but like a simple knot, similar to two knots which appear in the body of the more prominent formation; that the diameter of the formation is greatest at the point where the relief ends, as would be the case with a larva eating its way from the point corresponding with the "head" of the "serpent" and growing as it advanced toward the "tail"; that the first curve, which, on the serpent theory, the animal must have made in forcing its way under the bark, is so abrupt and the relief so doubled upon itself that a snake could not make such a bend without breaking its vertebræ; that the cephalic plates and scales are imaginary; that the curves shown, though natural to a burrowing larva, are not natural to a snake forcing itself into so confined a space; that the woody formation of the relief indicates a burrow beneath the larva, and not the forcing of anything between the bark and the wood, for such forcing would have loosened the bark for some distance on either side of the relief, and a forcing of the kind supposed could not take place without interference with the growth or soundness of the tree; that the granular appearance to be seen along the sides of the specimen and the fibers observable are just such as an insect-larva would leave, and can not be accounted for on M. Ollivier's hypothesis; that the animal matter in the center of the body may be accounted for as arising from the exuviæ and excrement of the larva; and that the work of human hands in heightening resemblances, particularly about the head and eyes, can be detected. The whole question, finally, could be readily settled by careful section, which would show traces of vertebræ or phosphate of lime along the vertebral line if there really were a serpent. Professor Gray, in the January number of the "American Journal of Science," suggests two explanations as more probable than that which depends upon the snake. One is, that the snake-like body is of the nature of a root, an aërial root, like those of a *Clusia* or a *Ficus*, which was making its way between bark and wood, and that the supposed larva is an incipient root of the same kind. The other, which was proposed by Professor Wadsworth, of Cambridge, while examining the specimen along with Professor Gray, "and is to be preferred," "supposes that the sinuous course is the track of a wood-eating larva or some kind of insect, the burrowing of which had not destroyed the overlying fiber; consequently the new growth filling the space (except at certain points) had naturally assumed the likeness of a snake."

Vital Conditions affecting the Colored Population.—Dr. S. S. Herrick, Secretary of the Louisiana State Board of Health, presented facts and tables at the Savannah meeting of the American Public Health Association, showing that, as between the two races, the rate of mortality for all ages is invariably much greater among the colored than among the white, and that the disparity is more marked in the case of children under five years of age. The colored race appears to enjoy an advantage in malarial fevers and cancerous diseases, while it is at a disadvantage in all the other diseases. Mr. Patterson's tables, exhibiting the increase by decades of the colored population in the United States, given in "The Popular Science Monthly" for September, 1881, show that the rate of increase during the decade, including the war, fell off by sixty or seventy per cent. The rate was, however, brought up to near its highest figure in the returns of the last census. The last fact is held by Dr. Herrick to correct the belief that the African race is destined to disappear in the struggle for existence. "Apparently, this race is increasing more rapidly than its white compatriot." The fact, however, which seems to have been overlooked, should be borne in mind, that the mulattoes and quadroons are all reckoned as colored, so that the increase is partly due to the whites. If the rapid increase of the colored race proves anything, it is that there is plenty of room yet for that class of people. This leads to the consideration of what will probably be the future of the colored people when they are crowded upon. "Whatever

may be the capacity of the race for development in a state of peace, it is apparent, from the great check on their increase between 1860 and 1870, by the operations of the civil war, that any serious disturbance of their industrial pursuits, like a prolonged foreign war or political convulsions at home, would produce such distress as to disturb profoundly their vital movements. The same event would follow an over-production of the staples grown by their labor, owing to their habitual improvidence. Thus far they have experienced no serious rivalry, and therefore no check to their natural increase. . . . This fact is undoubtedly favorable to the numerical increase of the race, though it is equally clear that it tends at the same time to delay its intellectual improvement by deterring individuals from pursuing other and higher industries. In any event, there is little danger that either race will severely encroach on the ground of the other in our time, and no danger that the colored population of any part of the country will be in the way of the whites, unless they should so far advance intellectually and morally as to win a commanding position by sheer force of merit."

Northern Transcontinental Survey.—A "Northern Transcontinental Survey" has been organized in the interest of the Northern Pacific Railroad and its allied lines, under the direction of Mr. Raphael Pumpelly, the purpose of which is to obtain a satisfactory knowledge of the extensive, hardly explored regions which may be made tributary to those lines and their resources. It has been divided into departments of mineral resources, climate, rivers and irrigation, soils, forests, economic botany, laboratory, and topography, which have severally been put in charge of specialists. A considerable amount of preliminary work was done last year, the most important, perhaps, of which related to the examination of the black coals of the western part of the region under survey and of the brown coal-fields of Dakota. The former coals were found to be good steam-generators, the latter not, except in combination or after special preparation. Particular attention is paid to the forest resources of the country, in which we are glad to see that the economical use of the timber is not wholly left out of sight; and observations are making on the useful grasses of the country. The results of the surveys are to be cartographically represented, in a series of maps delineating severally topographical, hydrographic, climatic, and botanical features.

Langley's Observations on Solar Radiation.—The scientific expedition of Professor S. P. Langley, of the Alleghany Observatory, to the summit of Mount Whitney, in 1881, has led to some important and novel conclusions with reference to the effect of the atmosphere on the action of the sun's rays, and to the temperature of space. Among the principal objects of the expedition were, to determine how much heat the sun sends to the earth (the solar constant), and what part of the surface temperature of the planet is due to the sun's direct radiant heat, and what part to the effect of the earth's atmosphere in storing this heat. Mount Whitney, in Southern California, was chosen, because of the conveniences afforded by its great height and the dryness of its atmosphere, and because two stations could be found upon it within easy signaling distance, and yet having a difference of more than eleven thousand feet in elevation. One of the earlier observations of the expedition was to notice, as former observers had done, "that as we ascended, and the air grew colder, the sun grew hotter, till our faces and hands, browned as they already were by weeks of sunshine below, were burned anew, and far more in the cold than in the desert heat. As we still slowly ascended, and the surface temperature of the soil fell to the freezing-point, the solar radiation became intenser, and many of the party presented an appearance as of severe burns from an actual fire, while near the summit the temperature in a copper vessel, over which were laid two sheets of plain window-glass, rose above the boiling-point, and it was certain that we could boil water by the direct solar rays in such a vessel among the snow-fields." This observation induced the conclusion that if the earth's atmosphere were withdrawn, the temperature of the surface would greatly fall, though under a materially greater radiant heat; and Professor Langley expresses the opinion that

the fall would be at least to 50° below zero of Fahrenheit. "We see," says Professor Langley, "if these results be true, that the temperature of a planet may, and not improbably does, depend far less upon its neighborhood to or remoteness from the sun than upon the constitution of its gaseous envelope; and, indeed, it is hardly too much to say that we might approximately indicate the constitution of an atmosphere which would make Mercury a colder planet than the earth, or Neptune as warm and habitable a one." A much greater value than has hitherto been accepted appeared to be given by the observations to the solar constant, amounting to one half more than that determined by Pouillet and by Herschel near the sea-level, and even to more than the recent values assigned by M. Violle. The bolometer observations at the summit and base of Mount Whitney indicate a different distribution of solar energy at the upper station from that which prevails at the lower one. They also indicate, as the author states in a communication to the French Academy of Sciences, that only one quarter of the solar energy which vivifies the world is found in the familiar field of the visible spectrum and the ultra-violet; and that the other three quarters are found in the infra-red. Thus the action of our atmosphere, and, as is inferred from the observations, that of the solar atmosphere, is to absorb the short rays more than the long ones. The real color of the photosphere is blue; and "white light is not the 'sum of all radiations,' nor even of all visually recognizable ones, but a composition of the small groups of special rays, which, starting from this essentially blue sun, by virtue of their large coefficients, and by a kind of survival of the fittest, have struggled through the solar and terrestrial atmospheres to us, while others of short wave-length have failed on the way."

Infectious Consumption.—Dr. Alexander McAldowie has considered the much-debated question whether pulmonary consumption is an infectious disease in the light of his own infirmary and private practice. He is of the opinion that it is infectious, although it is not so frequently communicated by infection as it would be were the lungs less well protected than they are against the access of germs. He mentions four cases where the wife, previously healthy, and with no family history of tubercular disease, became affected while attending to her phthisical husband, and two cases in which persons suffering from the pneumonic form of the disease appeared to communicate the tubercular form to healthy persons. Phthisis is not often communicated in this manner by ordinary intercourse, because the germs are sifted out in the air-passages by the vibrating action of the cilia situated there, and are removed by expectoration. The germs floating in the air are, moreover, commonly dry, and of feeble infective power. The lungs are liable to infection only when the inhaled germs escape the filtering action of the bronchi and reach the air-cells, where they come in contact with a surface highly favorable for their absorption. This happens only under exceptional conditions. The parts of the alveoli most exposed to the attacks of inhaled germs are those near the entrance, at the points where the small bronchial tubes lose their cylindrical character and become covered on all sides with the cells; and pathological observation has proved that these are frequent starting-points in phthisis.

Subterraneous Effects of Atmospheric Pressure.—Hardly sufficient account has been taken of the variations in the pressure of the atmosphere as a force competent to produce important effects within the earth and on its surface. The pressure on a man's body amounts to thirty thousand pounds, and that exerted upon a table ten feet long and five feet wide is equivalent to more than one hundred thousand pounds. In both these cases the pressure varies alike on all sides, and changes are not directly felt; but the cover of an air-tight box, the pressure in the interior of which could not vary, would act very differently, and would respond to the slightest changes. The crust of the earth probably — certainly where cavities exist—is like such a cover. The consideration of this fact may help to explain the connection which many persons think they have found between earthquakes and coal-mine explosions and low stages of the barometer. A part of the weight of

the atmosphere being removed, the gases confined within the earth exert a stronger pressure on the crust, or flow out and are inflamed when they reach a light. Mr. Baldwin Latham has found that the streams flowing through the chalk, even in dry seasons, give increased supplies of water when the barometer is falling, and diminished supplies when it is rising.

Mental Shock and Inebriety.—Dr. T. D. Crothers, Superintendent of Walnut Lodge, Hartford, Connecticut, has a paper in the "Quarterly Journal of Inebriety," the object of which is to show how psychical traumatism, or injury from mental agitation or powerful emotion, an agency whose operation is not generally recognized, is often an active cause of inebriety. He marks two distinct periods in all cases of inebriety, the first of which, beginning somewhere in the past, is unknown and not noticeable to ordinary observers, and terminates with the first excessive use of alcohol. The second period starts from this point, is noted by the occasional or continuous excessive use of spirits, is terminated only by recovery or death, and is the period which comes under the observation of friends and relatives, and can be accurately studied. The causes and conditions in the first, or neurotic stage, are often as varied and complex as those which produce insanity, and often, notwithstanding their obscurity, present distinct intimations of inebriety far in advance. "A certain progressive march may be noted, often broken by long obscure halts or precipitous strides, changing into various forms and manifestations of disease. The neurotic stage will be marked, in most cases, by nerve exhaustion, instability of nerve-force, and nutrient perversions. Not unfrequently delusions and hallucinations about foods and drinks are unmistakable symptoms. Often persons who have never used spirits, and become fanatical in their efforts to reform inebriates, are in this stage, and sooner or later glide into the next one." Psychical traumatism may be considered both as a direct cause of inebriety and as an indirect cause, as which it develops conditions that rapidly merge into the disorder. A number of incidents that have come under the author's observation, some of which are extremely striking, are given as illustrative of its operation from both points of view. In all of them inebriety has immediately or gradually supervened in persons who would have been the last to be suspected of liability to it, after some intense mental shock or surprise or information of disaster. The usual explanation of such cases, says Dr. Crothers, would be that the victims drank from despair and discouragement, "but a general study will show a state of psychical pain and agony for which alcohol alone acts as a sedative. It very commonly appears, in a study of cases of inebriety, that the patient will refer to some event of life, or disease, from which he is confident that he lost some power or force which he has never regained. These incidents do not come out as reasons for his drinking, but as facts pertaining to his vigor or power of endurance." Such cases of loss of power are found in every community, "and of course do not all become inebriates, but, like a large class of eccentrics, are on the border-line, or inner circle, shading into inebriety or insanity. A large number of persons engaged in the late civil war, who suffered hardship and mal-nutrition, became inebriates years after, following the psychical and physical traumatism received at that time. The effects of commercial disasters, of bankruptcies, and panics in Wall Street, can be seen in inebriate or insane asylums. In the asylum at Binghamton, New York, for inebriates, at one time were eighteen cases whose inebriety could be clearly traced to a great money-panic in Wall Street known as 'Black Friday.' Many of these cases were purely from psychical traumatism, others were already in the dark circle close to inebriety, and needed but a slight cause to precipitate them over. Political failures are also fertile fields for the growth of inebriety and the action of psychical influences. Annually a large class, after the close of a campaign, find themselves literally inebriates, and, if they have money, go to water-cures, inebriate asylums, or to the far West, and begin life again. The inebriety is often of the paroxysmal or dipsomaniacal type, with free intervals of sobriety that give renewed energy to the delusive hope that recovery will follow the bidding of the will. A class of moderate or occasional drinkers are al-

ways more susceptible to these influences than abstainers"; and it may be stated as a rule that moderate drinkers suffer more frequently from psychical shocks of every form, and are more likely to become inebriates from such causes.

The Poison of Cesspools.—M. Bouveret has reported on a remarkable case of poisoning from a cesspool which took place at Lyons. A workman, twenty-one years old, having fallen into a cesspool, was taken out, after having been in it about five minutes, in a state of convulsions. Inhalations of oxygen were administered for several hours, but the convulsions continued with rise of temperature. Transfusion of blood (defibrinated) was then tried without effect, and death took place about twenty-four hours after the accident. The blood was found, on *post-mortem* examination, to be black and fluid, the lungs and kidneys were congested, and the bronchial mucous membrane showed a bright hyperæmia, but no coagulation was observed in the pulmonary artery. The chief toxic agent in the contents of cesspools is supposed to be sulphide of ammonium, a poison which acts on the blood in the same manner as carbonic oxide, deoxidizing the red globules and making them unfit to perform their functions. Transfusion of blood has been performed with success in cases of poisoning by carbonic oxide, and its failure in the present case has provoked the suggestion that cesspools may contain gaseous poisons far more complex and more virulent than sulphide of ammonium, the action of which is more profound and complicated.

Ancient Maya Records.—Dr. Daniel G. Brinton, of Philadelphia, has recently come into possession of a number of *fac-simile* copies of the Books of Chilan Balam, or the local records of the Mayas of Yucatan, and has published an interesting account of their character and contents. The name, "Book of Chilan Balam," was applied to all the works of this character, to whatever village they might belong, and the different ones were distinguished by adding the name of the village. Only a few of the original volumes remain, most of them having been destroyed by the priests as heretical and mischievous; but a few were afterward compiled over again by natives from their own knowledge and recollections. Parts or descriptions of sixteen of these works remain, not one of which has ever been printed, or even entirely translated into any European tongue. Their contents consist chiefly of astrological and prophetic matters, ancient chronology and history, medical recipes and directions, and, in the later ones, later history and Christian teachings. One of the most valuable features in these records lies in the hints they furnish of the hieroglyphic system of the Mayas, concerning which our only information has hitherto been in the essay of Bishop Landa. Some features of Bishop Landa's notes on this subject have been condemned by Dr. Valentini, as we have already mentioned, as "fabrications," but Dr. Brinton pronounces Dr. Valentini's attack "an amount of skepticism which exceeds both justice and probability," and he believes that the result of a comparison with the hieroglyphics of the books of Chilan Balam and of the Codex Troano will refute the doubts and slurs that have been cast on the bishop's work, and "vindicate for it a very high degree of accuracy."

Lessons on the Danger of Narcotics.—The deceased poet, Dante Gabriel Rossetti, was a victim of chloral, which he took for sleeplessness, with the inevitable result. About 1868, his friend Mr. Watts says, in the "Athenæum," he was attacked with insomnia, one of the most distressing effects of which as manifested in him was "a nervous shrinking from personal contact with any save a few intimate friends. This peculiar kind of nervousness may be aggravated by the use of sleeping draughts, and in his case was thus aggravated. . . . No man ever lived who was so generous as he in sympathizing with other men's work, save only when the cruel fumes of chloral turned him against everything." Another conspicuous warning against the use of narcotics is given in the case of the death of Dr. Thomas Atkinson Elias, a physician of Southport, England, under circumstances which led the coroner's jury to believe that it was caused by an overdose of morphia. It was shown at the inquest that he was

occasionally troubled with sleeplessness and frequently took for it morphia, chloral, nepenthe, or bromide of potassium. It is lamentable, says the "Lancet," to see medical men drift into such uses of drugs, which engender the very evils for which they are taken, and are so apt to issue in results quite uncontemplated. "Such evils are to be cured, and meantime borne with patience, not met by dangerous medicines in random doses."

Mechanical and Vital Education.—"Some dangers of education" are treated with much intelligence in a thoughtful essay in the "Saturday Review." One of the dangers relates to the difference between what may be called mechanical and vital education. By mechanical education is meant "the imbuing the mind with those elements which can be taught by pure rule; in which no demand is made on the child or youth beyond attention and industry; into which the element of choice on his part does not enter. Such elements there are in every subject." Among them are the teaching of the alphabet, of the pronunciation of written words or syllables, of spelling, of writing, of the multiplication-table, of rules for the addition or subtraction of fractions, of many other arithmetical processes, and, in the higher subjects, the inculcation of the Greek and Latin grammar and vocabulary, of the propositions of Euclid, of historical dates and facts, and of many elements in the most difficult branches of learning, the processes of which are mechanical and nothing more. "But in all sound education these mechanical rules are never treated as an end in themselves, nor again as a mere stepping-stone to other mechanical rules of a more difficult kind. They are, each and all of them, keys to unlock the several successive chambers of the world in which we live; and, whether the treasures stored up in those chambers are of a material or spiritual kind, . . . the unfolding of these several treasures is not in any way a mechanical, it is a vital process. And here a totally new element comes in on the part of the student. It is no longer with him a matter of attention only; he will begin to exercise choice. It is found by experience that boys and girls are not incapable of taking interest in the world in which they live; but no prescribed plan for creating such an interest in them is possible. Thousands of interesting topics may be unfolded before the eyes of a boy, and he will have none of them: at last something occurs which touches him; curiosity or sympathy is awakened; and from that moment he takes an initiative, his vital education is on the move. And from that moment the mechanical inculcation of rules ought to be somewhat relaxed; not that it may not still be necessary sometimes, but it ought not to be suffered to interfere with the more important element—the spontaneous pursuit of knowledge, the spontaneous feeling of sympathy with men. Now, here is the delicate, the critical point in education, the point at which the teacher or the educational authority has such serious difficulties to contend with in making a decision. . . . There is a proper medium in the enforcement of the mechanical part of education: if it is enforced too little, there is the mischief attendant upon idleness on the child's part, besides the loss of the use of a valuable instrument; if it is enforced too much, vital energies will be quenched, and the whole result will be dry and formal." The tendency in the primary schools, and of all formal competition in the higher schools and universities, is to produce mechanical rather than vital excellence.

NOTES.

Dr. Charles M. Culver, of West Troy, a graduate of Union College and of the Albany Medical College, has been making the study of the eye a specialty under the guidance of eminent professional men in London, Berlin, and Paris, and is now an assistant of the celebrated oculist, Professor Landolt, at the French capital. Dr. Culver is at present engaged in translating from the French into English the treatise on "The Refraction of Light," by Professor Landolt, which forms the second volume of the comprehensive work on "Ophthalmology" by Wecker and Landolt. It will be an interesting contribution to our scientific literature.

Dr. George M. Beard, a physician well known for his investigations in nervous disorders, and the contributor of several articles to "The Popular Science Monthly," died in this city, January 23d, at the age of forty-three years.

MR. G. W. TINSLEY, of Columbus, Indiana, has suggested a new theory of the operation of solar and lunar gravities in producing the tides. The tide on the side of the earth nearest to the attracting bodies is induced by the acceleration of the rotation of the waters on that side causing them to rush up toward the point of greatest attraction. The tide on the opposite side is due to the formation of an axis of gravity by the combined attractions of the earth and moon, around the pole of which the water accumulates; in the same manner as if, when we had a fluid substance that a magnet would attract, and were to fill a vessel with it and hold a magnet under the vessel, we might expect the substance to accumulate to a greater depth immediately over the magnet than elsewhere.

THE Rev. James Challis, Plumian Professor of Astronomy, and Fellow of Trinity College, the senior of the professors at the University of Cambridge, died early in December, in the eightieth year of his age. He had actively discharged the duties of his professorship from 1836, when he was appointed to succeed Professor Airy, till within two years of his death. He published a considerable number of scientific works, including twelve volumes of astronomical observations.

THE "Moniteur Industriel" says that electrical force is regularly installed as the propelling power of the trains on the three railroads from Lichterfeld to Spandau, Prussia; from Port Bush to Busa Mills, Ireland; and from Zandvoort to Kostverloren, Holland. Electrical railway lines are in construction from Wiesbaden to Neroberg, Prussia; at Zankerode, in Saxony; a subterranean and subfluvial road in London; and one in South Wales, the motive power for which is derived from a fall of water. Of lines projected are the urban railways of the cities of Milan and Turin; the Edison Company's projected line in the United States; and the South Austrian Company's line.

SIGNOR ANTONIO FAVORO is about to publish a work on the career of Galileo while he filled the chair of Mathematics in the University of Padua, from 1592 to 1610, a period of Galileo's life concerning which little has been hitherto published. It will contain about a hundred and fifty documents, for the most part unedited.

SIR WOODBINE PARISH, a venerable English diplomatist, a former vice-president of the Geological and Geographical Societies, and author of a work on the "Natural History of Buenos Ayres and the Rio de la Plata," died recently, in the eighty-sixth year of his age. He was also known to the scientific world for having taken to England the remains of the megatherium, glyptodon, and other great South American fossils.

THE death is announced of Andrea Aradas, of Catania, Sicily, a laborious student of marine zoölogy and paleontology, whose numerous publications extended over a period of forty years.

THE Peabody Museum of Archæology has acquired a collection of contemporary potteries in various stages of manufacture, and pottery-making tools, of the Caribs of British Guiana, which were bought in person several years ago by Professor H. A. Ward from a Carib woman whom he was watching make earthen vessels. Among the articles were several small and rude vessels which Professor Ward saw the Indian woman form and give to her children to play with and amuse themselves while she continued her work. These toy-vessels suggest that many of the small objects of similar character found in mounds and graves may have been the playthings of children.

DR. GUSTAVE SVANBERG, formerly Professor of Astronomy and Director of the Observatory of the University of Upsala, Sweden, died November 21st, in his eighty-first year.

ONE of the largest brains on record is that of an illiterate, not very intelligent mulatto, of Columbus, Ohio, who recently died at the age of forty-five years, and whose case is reported by Dr. Haldeman in the "Cincinnati Lancet." His brain weighed 68¼ ounces, or nearly five ounces more than the famous brain of Cuvier. The case was mentioned, in our December number, of a bricklayer who could neither read nor write, whose brain weighed 67 ounces.

THE death of the Marquis Orazio Antinori, the distinguished zoölogist and African traveler, is reported from Aden. He had just started, at seventy-one years of age, on a new expedition to the Upper Nile.

ONE of the strongest evidences that practical education is destined hereafter to receive a fairer share of attention at the old universities is afforded by the fact that a course of lectures has been begun at Cambridge, under Professor Stuart, "On the Practice of Iron and Brass Founding, with Practical Demonstrations in the Foundry."

M. PALMIERI, Director of the Observatory on Mount Vesuvius, announces that he has discovered, in the lava of that volcano, a spectrum line corresponding to that of helium, the element whose spectrum has hitherto been found only in the sun.

THE French Academy of Sciences presented M. J. B. Dumas, the chemist, on the 4th of December, a gold medal, in commemoration of his having reached the fiftieth year of his membership of the body. M. Jamin, representing the Academy, expressed wonder that it had only taken fifty years to do as much as M. Dumas had accomplished.